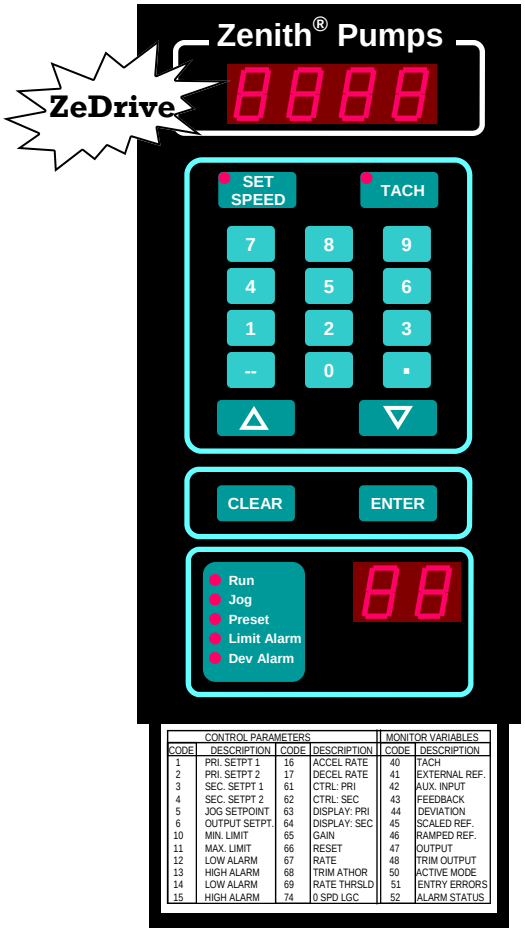
ZENITH PUMPS

Date: 03/2006

ZeDrive DC Motor Drive User Manual

Setup System Easily



CONTROL PARAMETERS				MONITOR VARIABLES	
CODE	DESCRIPTION	CODE	DESCRIPTION	CODE	DESCRIPTION
1	PRI. SETPT 1	16	ACCEL RATE	40	TACH
2	PRI. SETPT 2	17	DECEL RATE	41	EXTERNAL REF.
3	SEC. SETPT 1	61	CTRL: PRI	42	AUX. INPUT
4	SEC. SETPT 2	62	CTRL: SEC	43	FEEDBACK
5	JOG SETPOINT	63	DISPLAY: PRI	44	DEVIATION
6	OUTPUT SETPT.	64	DISPLAY: SEC	45	SCALED REF.
10	MIN. LIMIT	65	GAIN	46	RAMPED REF.
11	MAX. LIMIT	66	RESET	47	OUTPUT
12	LOW ALARM	67	RATE	48	TRIM OUTPUT
13	HIGH ALARM	68	TRIM ATHOR	50	ACTIVE MODE
14	LOW ALARM	69	RATE THRSLD	51	ENTRY ERRORS
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- **Typical Application Examples**
- **Detailed Explanation and Instructions**
- **Assistance for Calculation, Configuration and Wiring**

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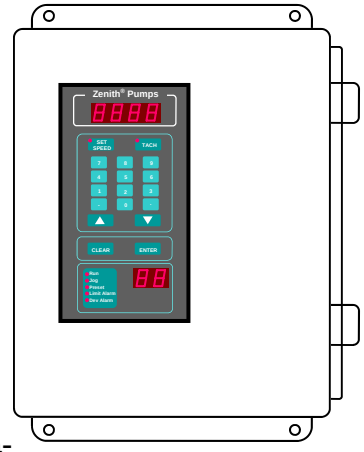
Introduction

This manual contains information required to complete installation, wiring, and startup operation for ZeDrive DC Motor Drive.

Be sure to follow all WARNINGS, CAUTIONS, and NOTES prior to proceeding with a particular task.

NOTE: Customer is required to make field wiring connections and adjust some of the protection codes dependent on specific applications.

Customer should become familiar with this manual to avoid electromagnetic interference (EMI) noise pickup, damage to equipment, and personal injury.



The standard ZeDrive DC Motor Drive consists of a ZeDrive, mounted in a NEMA 12 control cabinet. All internal cabinet wiring is complete and pre-wired to a terminal strip for customer terminations.

The unit is also pre-programmed according to customer specifications (except some protection codes dependent on specific applications).

The standard ZeDrive DC Motor Drive supports 1-phase 115/230VAC, 50/60Hz power input, which is selectable by a selection switch inside of the drive. It enables ZeDrive to drive DC motors from 1/4 to 2 HP.

Control cabinet size can be found in "ZeDrive NEMA 12 Standard Products". Depending on the requirements of customer's application, the control cabinet can also be changed.

Standalone version of ZeDrive DC Motor drive is available. An optional Analog IO card can be used for either 0~20mA or 0~10VDC analog signals, handling setpoints, feedback, or reference signal inputs, and output the value of any variable or parameter in the drive.

ZeDrive can receive three frequency inputs, supporting magnetic pickup (zero-crossing) or open collector type sensor. It comes standard with a RS-485 as well as a RS-422 computer interface, allowing to monitor or alter variables, parameters, as well as some command functions, such as run, stop.

In the event the drive assembly has to be located in a hazardous location, an optional intrinsically safe barrier is available to install in ZeDrive DC Motor drive cabinet to limit sensor current to safe levels.

Refer to "ZeDrive Standard Specification" on next page for additional features and specifications.

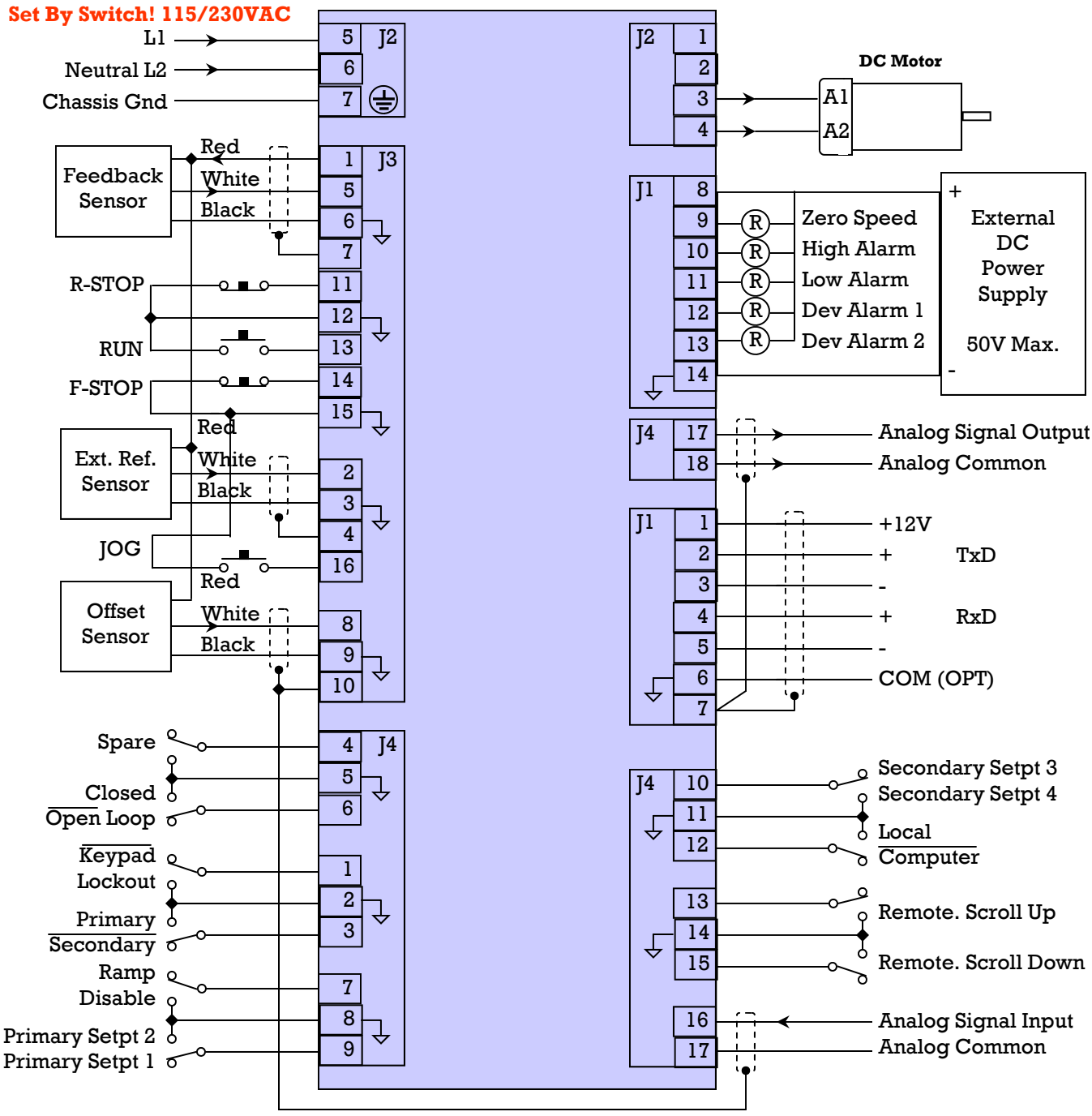
WARNINGS:

- Do not mount ZeDrive near heat-radiating elements or in direct sunlight.
- Do not install ZeDrive in a place subjected to high temperature, high humidity, excessive vibration, corrosive gasses or liquids, or airborne dust or metallic particles.
- Mount ZeDrive vertically and do not restrict the air flow to the drive.
- Allow sufficient space around the unit for heat dissipation. Approximately 6 inches should be allowed above and below the drive and 2 inches on each side.

ZeDrive Standard Specification

Voltage Class	Unit	115 VAC Class	230 VAC Class
Rated Input Voltage	VAC	115 (104 ~ 132), 1 Phase	230 (207 ~ 264), 1 Phase
Rated Input Frequency	Hz	60/50	
Horse Power Rating	HP	1/4 ~ 1	1/2 ~ 2
Rated Output Current	A	4 ~ 16 (Default: 15 Amp)	
Rated Output Voltage	VDC	0 ~ 90 Armature (100V Field)	0 ~ 180 Armature (200V Field)
Operating Temperature	˚C	0˚C ~ 55˚C	
Relative Humidity		0% ~ 90%, Non-condensing	
Cooling		Natural, air cooled	
NEMA Ratings		Standalone: NEMA 4, Enclosure: NEMA 12	
Classifications:		UL	
Closed Loop Accuracy		Master Format: 0.01% Set Speed; Follower Format: Zero accumulative error	
Tuning		Gain, Reset and Rate	
Scaling Format		Master, Follower, Offset, Direct	
Keypad Controls		Set Speed, Tach Display, Numeric Keys, Up/Down Buttons	
Serial Communication		RS-422, Full parameter access & control	
Protection		1 Amp internal fuse for control protection, 15 Amp internal fuse for armature protection	
Analog Inputs		0 ~ 10 VDC, or, 4 ~ 20 mA	
Analog Outputs	VDC	0 ~ 10 VDC, or, 4 ~ 20 mA	
Setpoints		6 Setpoints (4 Master/Follower, 1 Direct, 1 Jog)	
Control Inputs		Run, R-Stop, F-Stop, Jog, Closed/ Open-Loop, Primary/Secondary Mode, Primary Setpoint Select, Secondary Setpoint Select, Ramp Disable, Keypad Lockout, Local/Computer	
Frequency Input		Zero Crossing(Magnetic Pickup), 0 ~ 10KHz for Feedback, External Reference, and Offset, or Open-collector (Encoder/Proximity), 0~30KHz for Feedback & External Reference, 0 ~ 10KHz for Offset	
Status Outputs		Hi Alarm, Lo Alarm Ramped Error, Scaled Error Zero Speed	

Standalone ZeDrive Wiring Diagram



Sensors	Ch A+	Ch A -	Ch B+	Ch B -	Common	Power
Magnetic Pickup	WHT or GRN	——	——	——	BLK & Shield	——
Hall Effect	WHT or GRN	——	——	——	BLK & Shield	RED
Encoder	WHT	——	——	——	BLK & Shield	RED

Installation

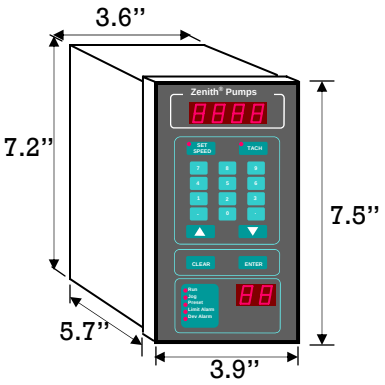
WARNINGS:

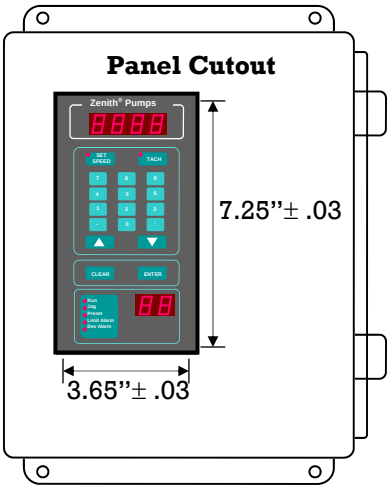
- Danger of electrical shock or severe injury. Remove all jewelry prior to working on electrical equipment
- Ensure electrical power is "OFF" before working inside the equipment
- Do not remove circuit protective devices, or any other components until power is turned "OFF".

NOTE: The installation of this motor control must conform to area and local electrical codes. For information, refer to the National Electrical Code (NEC) Article 430 published by the National Fire Protection Association, or the Canadian Electrical Code (CEC). Refer to local codes as applicable.

Mounting:

- Ensure the mounting location meets the environmental conditions such as humidity and temperature (refer to "ZeDrive Standard Specification" on Page 2) for ZeDrive
- Determine appropriate door or panel location and make the panel cutout per figure shown at the left
- Remove (2 ea.) locking cam fasteners from ZeDrive housing assembly, by removing (2 ea.) screws, one from each cam fastener (top and bottom)
- Insert ZeDrive from the panel front and slide it in until it is flush with the panel surface. Ensure that supplied gasket is between the drive bezel and panel surface.
- Re-install the locking cam fasteners from the rear of the controller on top and bottom of housing assembly. Rotate the cam fasteners so that ZeDrive pulls securely against the panel surface.
- Tighten locking cam fastener (2 ea.) screws (top and bottom)





Wiring Instructions

ZeDrive will arrive with all internal wiring of NEMA 12 cabinet complete, for most customer requirements. Customers will be required to wire to the terminal strip mounted inside the cabinet. If customers desire to use some available functions of ZeDrive that are considered non-routine, customers may have to wire to ZeDrive, too.

If ZeDrive is ordered as a NEMA 4 standalone drive, customers are required to make all connections to the drive.

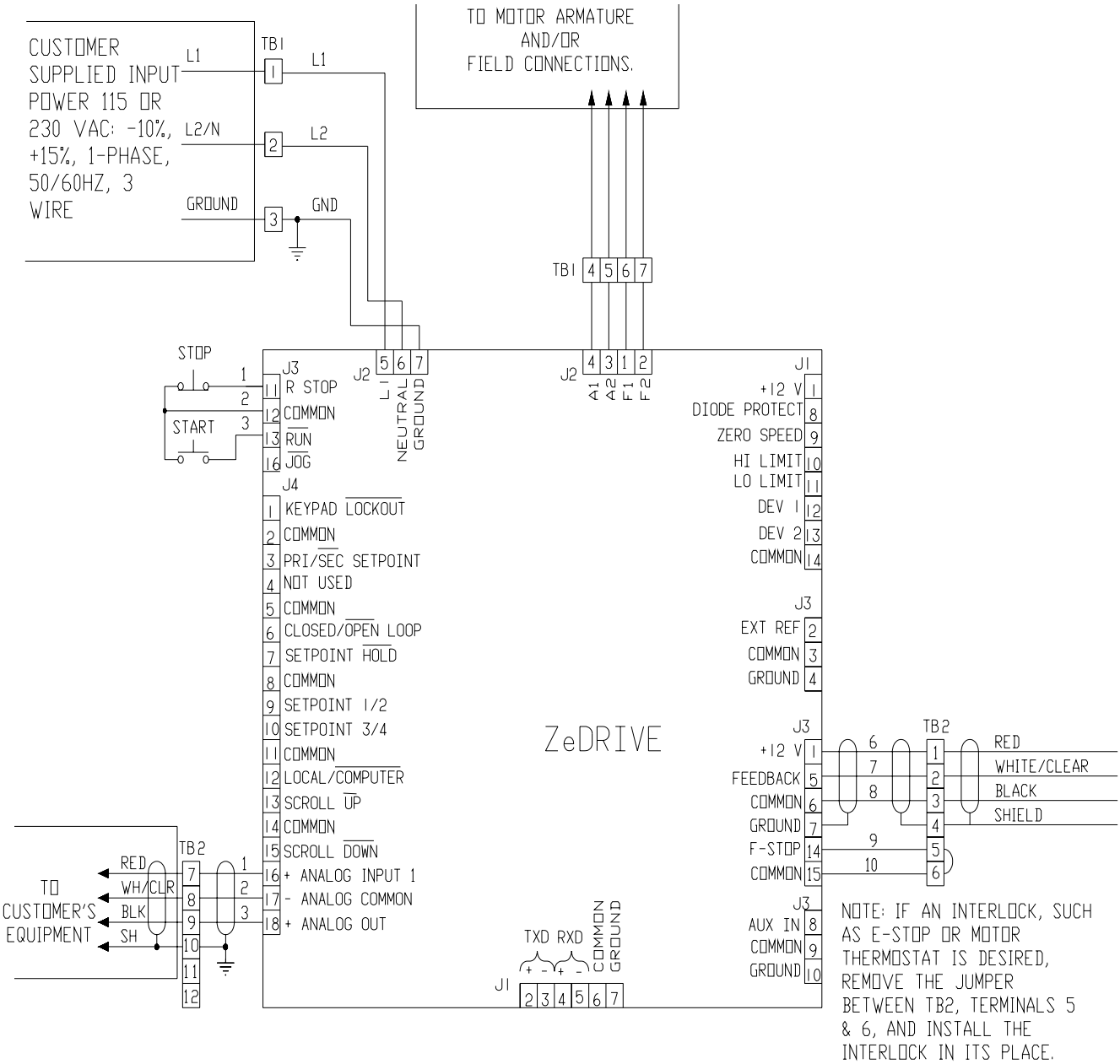
CAUTION: TO PREVENT PERSONNEL ELECTROCUTION OR DAMAGE TO THE EQUIPMENT, MAKE SURE ALL POWER TO ZEDRIVE IS REMOVED BEFORE MAKING ANY WIRING CONNECTIONS OR CHANGES.

Wiring practices must conform to applicable local electric codes and the National Electric Code (NEC). If installed in a country outside the USA, wiring practices should conform to the electric codes of the country ZeDrive is installed in.

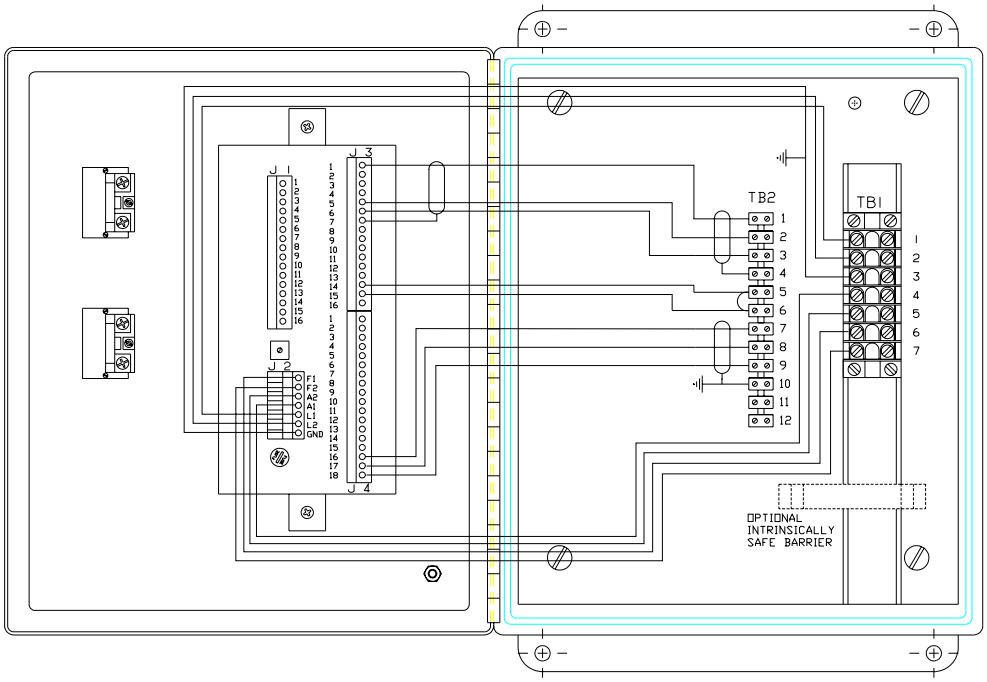
- Input power to the control cabinet must be supplied through an appropriately sized circuit breaker or fused disconnect that is within easy reach of the cabinet. In high noise environments, install an isolation transformer on the input AC power
- The control cabinet ground must be a single point termination and be at a resistance of less than 1 ohm with relation to true earth. All grounds within the control cabinet must be connected to the single point ground termination.
- Use arc suppressors across the coil of all AC relays and contactors
- High voltage wiring (> 50 V) must be run in separate conduit from low voltage (<50 V) or signal wiring. If run parallel to each other, high voltage wiring should be separated from low voltage and signal wiring by 12 inches or as much as physically possible. If they must cross each other, they should cross perpendicularly. Do not route 115 VAC control wiring and low level signal wiring in the same conduit. Do not route feedback wiring along the motor case. Motor armature and field leads must be run separate from shielded signal cable to avoid signal EMI noise in feedback
- Shielded cable should be used for signal wiring to prevent electrical noise contamination. The shield should be terminated at ZeDrive only. (**NOTE**: Terminating the shield at both ends causes ground loops and defeats the purpose of using shielded cable).
- Low voltage wiring making long runs outside a control cabinet should use shielded cable also. Shield termination should be at the end of the equipment requiring the most noise protection. (**NOTE**: In some cases, this may be the PC or PLC, rather than ZeDrive).
- Field wiring entails connecting power input, motor armature and feedback signal wiring

NOTE: NEMA 12 enclosure is not provided with any pre-punched conduit holes. Customers are required to punch holes in the enclosure to facilitate field wire entrance. Customers should ensure that the entrance holes and conduit conform to local wiring codes.

Control Cabinet Wiring



Field Wiring

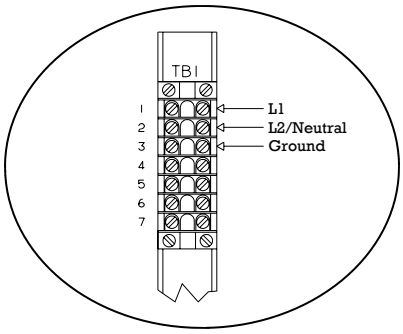


1. Connect Input Power

Customer supplies input AC power

NOTE: Make sure to set power selection switch to correct power voltage configuration

- 115/230 VAC, -10%, +15%
- 1-Phase
- 50/60 Hz
- 3 Wire

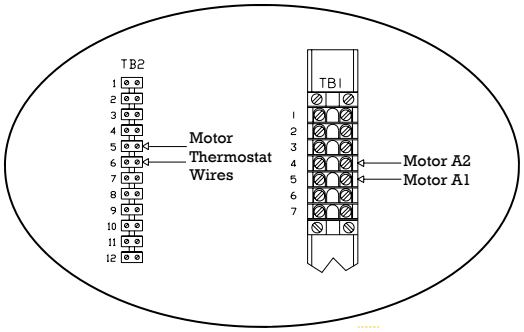


Field Wiring (cont'd)

2. Connect DC Motor Cable

- **Permanent Magnet DC Motors**

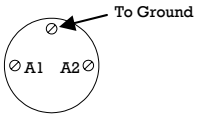
Permanent magnet motor has only two motor connections for its armature. The connections may be labeled A1 and A2, or may be color coded. Select the right motor from the connection diagrams below.



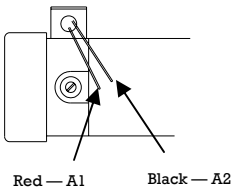
NOTE:

- **Always refer to pump drawing for correct pump rotation. To change rotation, reverse A1 and A2 connections**
- **The motor connections shown above will produce a counter-clockwise rotation at the reducer output shaft, viewed from the pump end (as opposed to the motor end). This rotation should be correct for most applications. If the rotation is incorrect, reverse A1 and A2 connections**
- **If the motor in use has a thermostat, it may be connected to TB2-5 and TB2-6, after removing the jumper**

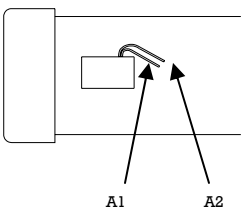
1/4, 1/2 HP TENV & Sealed Tight (Wash Down) Motors
(Motor End Cover Removed)



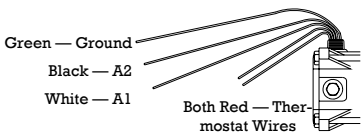
1 & 2 HP Wash Down Motors



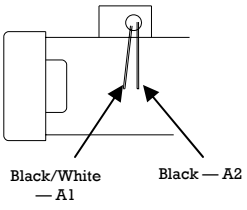
2 HP TEFC Motors



1/2 HP Explosion Proof Motors



1 HP TEFC Motors



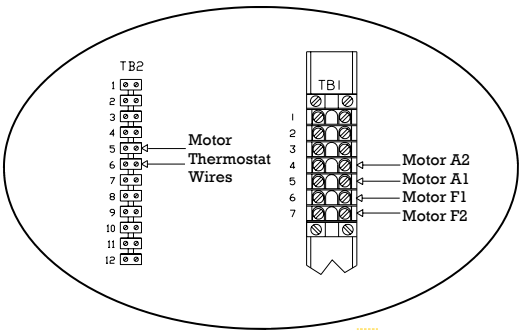
Field Wiring (cont'd)

2. Connect DC Motor Cable (cont'd)

- **Field Wound DC Motors**

Field wound motor has connections for its armature and field. Its armature connections will be labeled A1 and A2. Its field will have 4 wires.

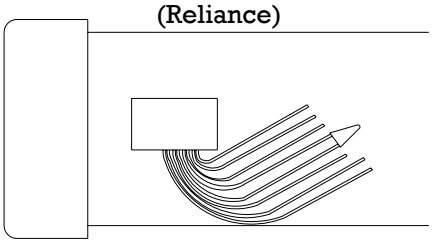
Select your motor from the connection diagrams below.



NOTE:

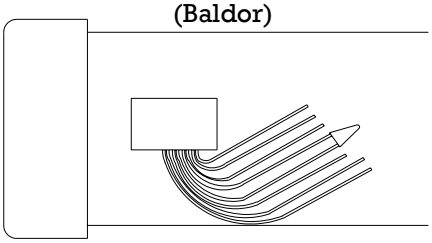
- **Always refer to pump drawing for correct pump rotation. To change rotation, reverse A1 and A2 connections**
- **The motor connections shown above will produce a counter-clockwise rotation at the reducer output shaft, viewed from the pump end (as opposed to the motor end). This rotation should be correct for most applications. If the rotation is in-correct, reverse A1 and A2 connections**
- **If the motor in use has a thermostat, it may be connected to TB2-5 and TB2-6, after removing the jumper**

2 HP Explosion Proof Motors
(Reliance)



Wire Label	Connect With
A1	TB1-5 (A1)
A2	TB1-4 (A2)
F1	TB1-6 (F1)
F2	Short with F11
F11	Short with F2
F22	TB1-7 (F2)
P1 Thermostat	TB2-5 (Thermostat)
P2 Thermostat	TB2-6 (Thermostat)

1 HP Explosion Proof Motors
(Baldor)

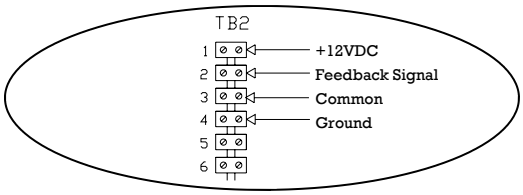


Wire Label	Connect With
A1	TB1-5 (A1)
A2	TB1-4 (A2)
F1	TB1-6 (F1)
F2	Short with F3
F3	Short with F2
F4	TB1-7 (F2)
J Thermostat	TB2-5 (Thermostat)
J Thermostat	TB2-6 (Thermostat)

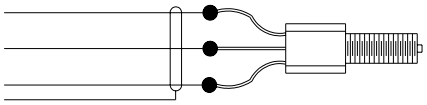
Field Wiring (cont'd)

3. Connect Feedback Signal Cable

Magnetic pickup or hall effect sensor is usually located between motor and reducer. Encoder is usually located at the rear of motor.

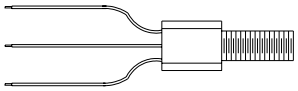


Hall Effect Sensor



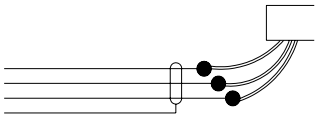
Wire Color	Function	Connect To
Red	+12VDC	TB2-1
White/Clear	Feedback Signal	TB2-2
Black	Common	TB2-3
Bare	Shielding	TB2-4

Explosion Proof Magnetic Pickup



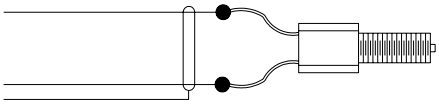
Wire Color	Function	Connect To
White	Feedback Signal	TB2-2
Black	Common	TB2-3
Green	Shielding	TB2-4

Encoders



Wire Color	Function	Connect To
Red	+12VDC	TB2-1
White/Clear	Feedback Signal	TB2-2
Black	Common	TB2-3
Bare	Shielding	TB2-4

Non-Explosion Proof Magnetic Pickup

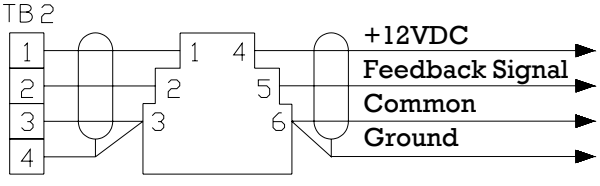


Wire Color	Function	Connect To
White/Clear	Feedback Signal	TB2-2
Black	Common	TB2-3
Bare	Shielding	TB2-4

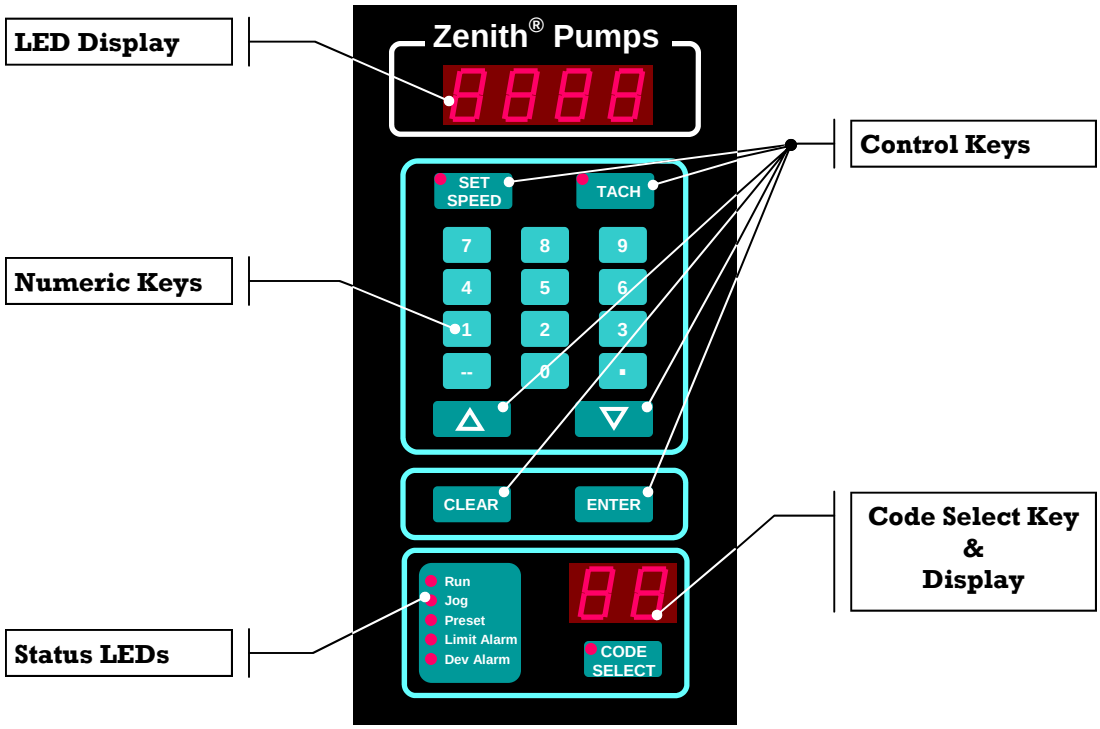
NOTE:

WHEN USING A HALL EFFECT SENSOR OR ENCODER IN A HAZARDOUS ATMOSPHERE, THE OPTIONAL INTRINSICALLY SAFE BARRIER MUST BE USED.

Optional Safety Barrier



Keypad & Display

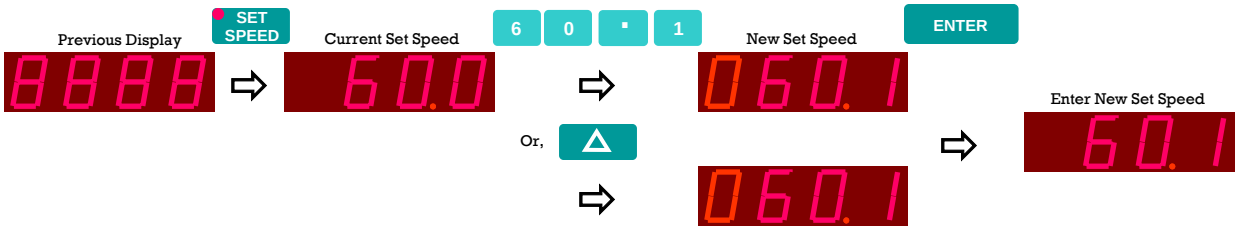


- **LED Display:**
  To display values for parameters
- **Numeric Keys:**
  To input values for parameters, or to input code number when "CODE SELECT" button being pressed
- **Status LEDs:**
  To display operation status and alarms
- **Control Buttons:**
  SET SPEED: To enter new set speed values in engineering unit
  TACH: To show the actual feedback signal in engineering unit
  Scroll Buttons: To increase/decrease the value showing in LED display
  CLEAR: To erase value in LED display, or code number under code select mode
  ENTER: To enter new value of a code, or to show the value of a code

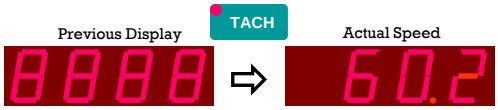
Code Select Key & Display:
CODE SELECT: To view or change values for any code
Code Display: To display code number

Keypad Operations

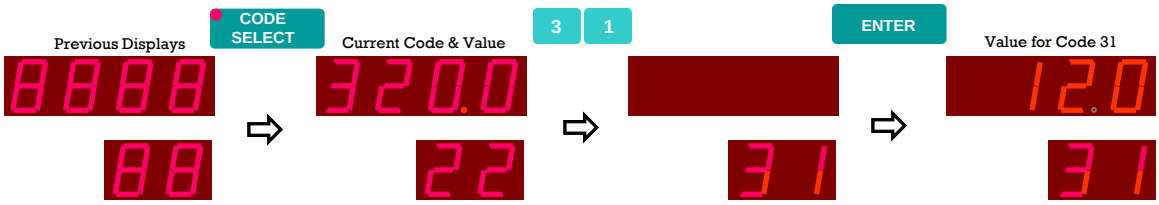
Set New Speed Value



Tach Display



Select Code & View Its Value



Modify Value

Standard Programming

NOTE: The codes below should meet the needs of most users for normal pump operations. If other functions are desired from ZeDrive, consult "Complete Code List".

Code	Description	Value/Calculation	Meaning
01	Primary Setpoint 1	User Defined	Pump speed setpoint (in Pump RPM)
10	Minimum Limit	0	Minimum motor speed for operation
11	Maximum Limit	1800	Maximum motor speed for operation
12	Low Alarm	0	Motor speed level which Low Alarm output is energized
13	High Alarm	1800	Motor speed level which High Alarm output is energized
16	Acceleration Time	10	Seconds for motor to increase from 0 RPM to 1800 RPM
17	Deceleration Time	5	Seconds for motor to decrease from 1800 RPM to 0 RPM
20	Primary Setpoint Maximum	1800/Gear Ratio	Unit of primary setpoint is in Pump RPM
22	Primary Display Maximum	1800/Gear Ratio	Unit of primary display is in Pump RPM
31	PPR—Feedback Input	120	The resolution of the feedback sensor used in the system
34	Max. RPM Feedback - Primary	1800	Full-scale speed of motor
61	Primary Output Format	1	Master Mode
63	Primary Display Format	1	Master Mode
84	Analog Input Function Select	0	Analog input not used

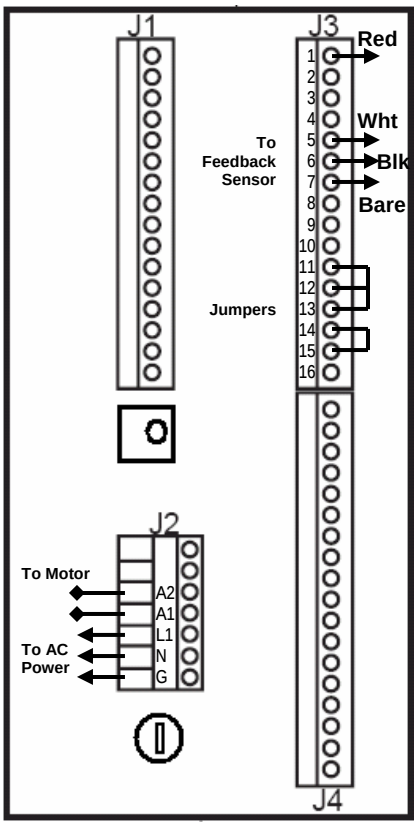
Typical Applications & Solutions

Quick Test for ZeDrive

1. Prepare the ZeDrive:

- Place jumpers on J3 connector between
  Pin 11 - Pin 12
  Pin 13 - Pin 12
  Pin 14 - Pin 15
- Connect power wires to J2 connector Pin L1, Neutral and Chassis GND (**Do NOT turn on power at this time**)

Back Panel of ZeDrive



2. Prepare the Sensor:

- Screw the sensor into the thread hole located on the gear reducer, until it hits the inside pickup gear, and back up about 1/8 of a turn (45 degrees)
- If it is a 2-wire sensor, connect
  White wire - J3 Pin 5
  Black wire - J3 Pin 6
  Bare wire - J3 Pin 7
- If it is a 3-wire sensor, connect
  Red wire - J3 Pin 1
  White wire - J3 Pin 5
  Black wire - J3 Pin 6
  Bare wire - J3 Pin 7

3. Connect Power to the Drive:

- Turn the 120 VAC power on for the ZeDrive
- **If the power is 230 VAC, please refer to "Trouble-shooting" section**

4. Configure ZeDrive:

A 5.091:1 reducer and 120 teeth pickup gear is used for the following example.

Change values for codes 20, 22 and 31 based on the system.

Code	Description	Formula	Default	Operation
20	Primary Setpoint Eng. Unit	1800/Gear Ratio (i.e., 5.091:1)	353.6	CODE SELECT 2 0 ENTER 3 5 3 . 6 ENTER
22	Primary Display Eng. Unit	1800/Gear Ratio (i.e., 5.091:1)	353.6	CODE SELECT 2 2 ENTER 3 5 3 . 6 ENTER
31	No. of Teeth of Feedback Gear	120	120	CODE SELECT 3 1 ENTER 1 2 0 ENTER
34	Primary RPM Max Feedback	1800	1800	CODE SELECT 3 4 ENTER 1 8 0 0 ENTER
61	Primary Scaling Format	1	1	CODE SELECT 6 1 ENTER 1 ENTER
63	Primary Display Format	1	1	CODE SELECT 6 3 ENTER 1 ENTER

Quick Test for ZeDrive (cont'd)

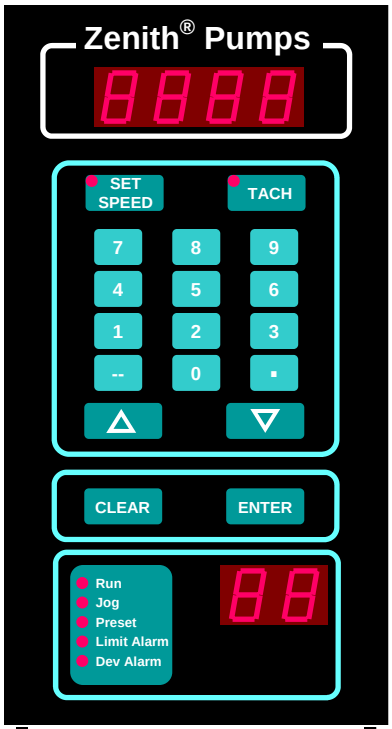
5. Verify Feedback Signal Manually:

- Click TACH
- Turn the reducer shaft by a wrench
- Non-zero number should be shown on the top display, whenever the shaft turns
- If there always is "0" on the top display, something is wrong related to feedback. Please refer to "Trouble-shooting" section

6. Run the System:

Let reducer's shaft run at 60 rpm, click SET SPEED 6 0

- If the system can not run, please refer to "Trouble-shooting" section
- If the system does not run at right speed, please refer to "Trouble-shooting" section
- If the motor runs away at max. speed, something is wrong related to feedback. Please refer to "Trouble-shooting" section
- If the system runs at right speed, stop the system and disconnect the power. The system is ready for normal operation

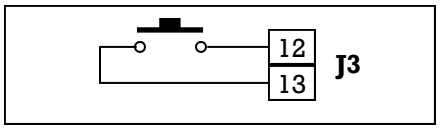


CONTROL PARAMETERS				MONITOR VARIABLES	
CODE	DESCRIPTION	CODE	DESCRIPTION	CODE	DESCRIPTION
1	PRI. SETPT 1	16	ACCEL RATE	40	TACH
2	PRI. SETPT 2	17	DECEL RATE	41	EXTERNAL REF.
3	SEC. SETPT 1	61	CTRL: PRI	42	AUX. INPUT
4	SEC. SETPT 2	62	CTRL: SEC	43	FEEDBACK
5	JOG SETPOINT	63	DISPLAY: PRI	44	DEVIATION
6	OUTPUT SETPT.	64	DISPLAY: SEC	45	SCALED REF.
10	MIN. LIMIT	65	GAIN	46	RAMPED REF.
11	MAX. LIMIT	66	RESET	47	OUTPUT
12	LOW ALARM	67	RATE	48	TRIM OUTPUT
13	HIGH ALARM	68	TRIM ATHOR	50	ACTIVE MODE
14	LOW ALARM	69	RATE THRSLD	51	ENTRY ERRORS
15	HIGH ALARM	74	0 SPD LGC	52	ALARM STATUS

Connect Run/Stop Buttons

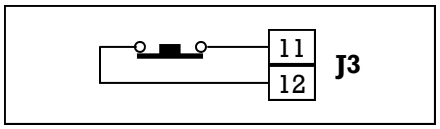
1. Run Button:

- Use a momentary button
- Connect the button to J3 connector Pin 12 and Pin 13
- When closed, ZeDrive will ramp up based on Acceleration Time defined in Code 16



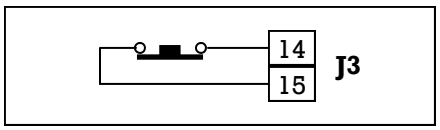
2. Stop Button:

- Use a momentary button
- Connect the button to J3 connector Pin 11 and Pin 12
- When opened, ZeDrive will ramp down to zero speed based on Deceleration Time defined in Code 17



3. Emergency Stop Button:

- Use a momentary button
- Connect the button to J3 connector Pin 14 and Pin 15
- When opened, ZeDrive will stop immediately



Set and Display as Pump RPM

1. Preliminary Action:

- Reducer Gear Ratio — R. If the pump is directly coupled with the motor, the gear ratio R=1
- Motor maximum speed — V_M (RPM)

2. Calculation:

None

3. Coding:

Check and change the following codes

Code 10 = 0
Code 11 = V_M
Code 20 = V_M / R
Code 22 = V_M / R
Code 34 = V_M
Code 37 = V_M

4. Wiring:

No wiring changes for this application

5. Result:

- The units of the setpoint and Tach on the drive's panel will be in Pump's RPM

Set and Display as "cc/min"

1. Preliminary Action:

- Reducer Gear Ratio — R. If the pump is directly coupled with the motor, the gear ratio R=1
- Motor maximum speed — V_M (RPM)
- Pump Capacity — C_P (cc/rev)

2. Calculation:

None

3. Coding:

Check and change the following codes

Code 10 = 0
Code 11 = V_M
Code 20 = V_M / R × C_P
Code 22 = V_M / R × C_P
Code 34 = V_M
Code 37 = V_M

4. Wiring:

No wiring changes for this application

5. Result:

- The units of the setpoint and Tach on the drive's panel will be in (cc/min)

Set and Display as Other Units

1. Preliminary Action:

- Reducer Gear Ratio — R. If the pump is directly coupled with the motor, the gear ratio R=1
- Motor maximum speed — V_M (RPM)
- Pump Capacity — C_P (cc/rev)
- Coefficient between other unit and "cc/min" — K_U
- **NOTE: It supports the customer's unit only in (volume/time) format**

2. Calculation:

2.1 Coefficient between other unit and "cc/min" — K_U:

- Find out 1 new volume unit is equal to V (cc)
- Find out 1 new time unit is equal to T (min)
- 1 (volume/time) = V (cc) / T (min) = V/T (cc/min)

$K_U = V/T$

Example:
If the preferred unit is (gallon/hour),
1 (gallon) = 3785 (cc)
1 (hour) = 60 (min)
1 (gallon/hour) = 3785 (cc) / 60 (min) = 63.08 (cc/min)
Therefore, $K_U = 63.08$

3. Coding:

Check and change the following codes

Code 10 = 0
Code 11 = V_M
Code 20 = $V_M / R \times C_P / K_U$
Code 22 = $V_M / R \times C_P / K_U$
Code 34 = V_M
Code 37 = V_M

4. Wiring:

No wiring changes for this application

5. Result:

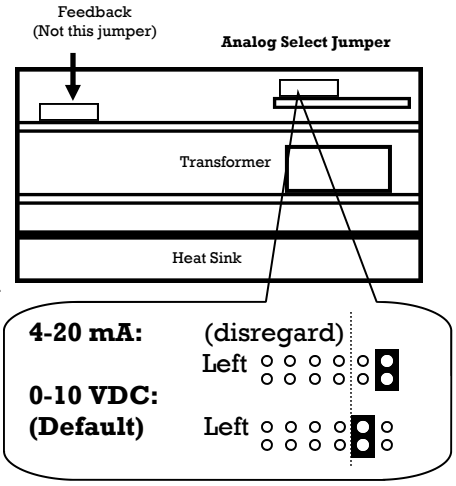
- The units of the setpoint and Tach on the drive's panel will be in customer's unit (volume/time)

Remote Monitoring Operation

1. Preliminary Action:

- To monitor system variables and control parameters, you need a monitoring device, accepting either 4-20 (mA) or 0-10 (VDC) analog signal
- Locate Analog Select Jumpers on "Control Board":
  1. Loosen up 6 screws on the back panel, and 2 screws located on the heat sink of ZeDrive
  2. Remove the back panel, place ZeDrive as shown at left. The top board is the "Control Board", and the bottom one is "Drive Board"
  3. Locate Analog Select Jumper as shown at left
  4. Depend on the signal, change the jumper setting as shown at the left

Analog Select Jumper Location



2. Calculation:

None

3. Coding:

Check and change the following codes

- Code 80 = ?? (input corresponding code number for monitoring that specific variable)

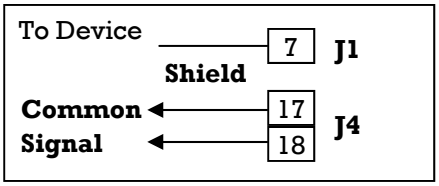
  Example: Code 80 = 40, it will monitor TACH, which is defined by Code 40

- Code 81 = ?? (defines the analog output range, usually the maximum value of the variable)

  Example: Code 81 = 1800, when TACH = 1800 (RPM), it outputs 10VDC or 20mA

4. Wiring:

- Connect the wires of the monitoring device with the ZeDrive as shown at the left



5. Result:

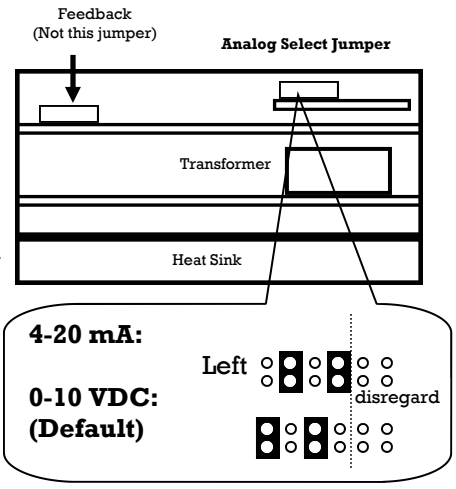
- Provide an analog signal indicating the status of ZeDrive variables and control parameters
- Support either 4-20 (mA) or 0-10 (VDC) analog signal

Use 4-20 (mA) as Setpoint

1. Preliminary Action:

- External device which supplies 4-20 (mA) speed set-point signal to ZeDrive
- Locate Analog Select Jumpers on "Control Board":
    1. Loosen up 6 screws on the back panel, and 2 screws located on the heat sink of ZeDrive
    2. Remove the back panel, place ZeDrive as shown at left. The top board is the "Control Board", and the bottom one is "Drive Board"
    3. Locate Analog Select Jumper as shown at left
    4. Depend on the signal, change the jumper setting as shown at the left

Analog Select Jumper Location



- Pump Capacity — C_P (cc/rev)
- Reducer Gear Ratio — R. If the pump is directly coupled with the motor, the gear ratio R=1
- Motor maximum speed — V_M (RPM), 1800 (RPM) for most of systems supplied by Zenith
- No. of Teeth of Feedback Gear — N, 120 for most of systems supplied by Zenith

2. Calculation:

- To set the motor speed to be V (RPM) ($0 \le V \le V_M$), the pump to be V (RPM) ($0/R \le V \le V_M/R$), or the output to be V (cc/min) ($0/R \times C_P \le V \le V_M/R \times C_P$), the corresponding formula for the mA current value C_{mA} is:

$$C_{mA} = (20 - 4) / (V_M - 0) \times V + 4 \text{ (mA)}$$
$$C_{mA} = (20 - 4) / (V_M/R - 0/R) \times V + 4 \text{ (mA)}$$
$$C_{mA} = (20 - 4) / (V_M/R \times C_P - 0/R \times C_P) \times V + 4 \text{ (mA)}$$

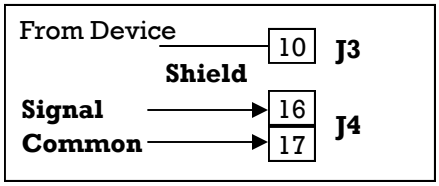
3. Coding:

Check and change the following codes

Code 20 = Max. Setpoint in Engineering Unit (refer to sections "Set and Display as …")
Code 22 = Max. Display in Engineering Unit (refer to sections "Set and Display as …")
Code 31 = N
Code 34 = V_M
Code 61 = 1
Code 63 = 1
Code 84 = 4

4. Wiring:

- Connect the wires of the 4-20 (mA) speed control signal with the ZeDrive as shown at the left



5. Result:

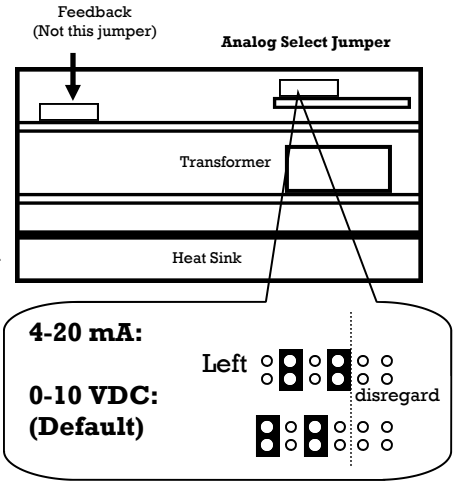
- 4-20 (mA) signal can be used to control the speed of ZeDrive

Use 0-10 (VDC) as Setpoint

1. Preliminary Action:

- External device which supplies 0-10 (VDC) speed set-point signal to ZeDrive
- Locate Analog Select Jumpers on "Control Board":
  1. Loosen up 6 screws on the back panel, and 2 screws located on the heat sink of ZeDrive
  2. Remove the back panel, place ZeDrive as shown at left. The top board is the "Control Board", and the bottom one is "Drive Board"
  3. Locate Analog Select Jumper as shown at left
  4. Depend on the signal, change the jumper setting as shown at the left

Analog Select Jumper Location



- Pump Capacity — C_P (cc/rev)
- Reducer Gear Ratio — R. If the pump is directly coupled with the motor, the gear ratio R=1
- Motor maximum speed — V_M (RPM), 1800 (RPM) for most of systems supplied by Zenith
- No. of Teeth of Feedback Gear — N, 120 for most of systems supplied by Zenith

2. Calculation:

- To set the motor speed to be V (RPM) ($0 \le V \le V_M$), the pump to be V (RPM) ($0/R \le V \le V_M/R$), or the output to be V (cc/min) ($0/R \times C_P \le V \le V_M/R \times C_P$), the corresponding formula for the control voltage C_{VDC} is:

$$C_{VDC} = (10 - 0) / (V_M - 0) \times V \text{ (VDC)}$$
$$C_{VDC} = (10 - 0)/ (V_M/R - 0/R) \times V \text{ (VDC)}$$
$$C_{VDC} = (10 - 0)/ (V_M/R \times C_P - 0/R \times C_P) \times V \text{ (VDC)}$$

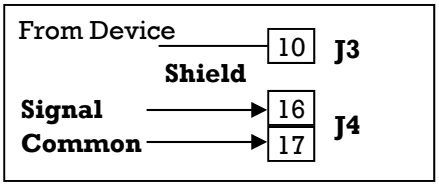
3. Coding:

Check and change the following codes

Code 20 = Max. Setpoint in Engineering Unit (refer to sections "Set and Display as …")
Code 22 = Max. Display in Engineering Unit (refer to sections "Set and Display as …")
Code 31 = N
Code 34 = V_M
Code 61 = 1
Code 63 = 1
Code 84 = 4

4. Wiring:

- Connect the wires of the 0-10 (VDC) speed control signal with the ZeDrive as shown at the left



5. Result:

- 0-10 (VDC) signal can be used to control the speed of ZeDrive

Feedback Control by Using a Flowmeter with Frequency Signal

1. Preliminary Action:

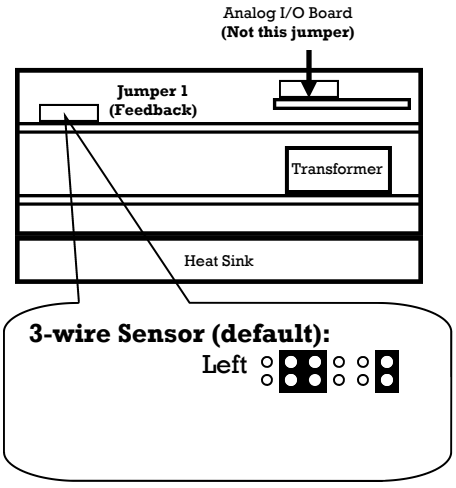
- A flowmeter which can send frequency flow signal to ZeDrive
- Max. Flowrate — F_m (cc/min) (or, in other units. Find out from the flowmeter)
- Max. Frequency Output — Q_m (Hz) (Find out from the flowmeter)
- Pump Capacity — C_P (cc/rev)

2. Calculation:

2.1 Equivalent Pulses Per Revolution of Motor — N_p (pulses/rev)

Therefore, $N_p = Q_m / 30$ (pulses/rev)

Feedback Jumper Location



3. Coding:

Check and change the following codes

Code 08 = Hall Effect (***for ZeDrive 2000 ONLY***)
Code 10 = 0
Code 11 = 1800
Code 20 = F_m
Code 22 = F_m
Code 31 = Q_m /30
Code 34 = 1800
Code 61 = 1
Code 63 = 1
Code 84 = 0

4. Wiring:

- For ZeDrive 2000, please proceed to the next step. For a regular ZeDrive, check and change the jumper settings on the "Control Board":
    1. Loosen up 6 screws on the back panel, and 2 screws located on the heat sink of Ze-Drive
    2. Remove the back panel. Face the back of ZeDrive and place ZeDrive so that the heat sink points down. The top board is the "Control Board", and the bottom one is "Drive Board"
    3. Locate Feedback Jumper as shown at left
    4. Please check the jumper settings as shown at the left, and make changes as neces-sary
- Disconnect the original feedback sensor
- Connect the wires from the flowmeter as follow:
  Frequency signal wire - J3 Pin 5
  Signal common wire - J3 Pin 6
  Shield wire - J3 Pin 7
- Leave anything else unchanged as before

Feedback Control by Using a Flowmeter with Frequency Signal (cont'd)

5. Result:

- The output from the pump will be controlled by the flowmeter
- The units of the setpoint and the Tach are same as the unit of F_m

6. IMPORTANT NOTE:

- The unit of the setpoint is in (cc/min), and **no longer in (RPM)**
- The pump speed may vary at very wide range. **Do not to exceed the factory suggested speed limit**
- **Any restriction at the discharge side of the pump can rapidly increase the speed of pump.** This is the major causation making the pump over-speed. Check any down-stream restrictions before the operation.
- **Always test the system without any down-stream restrictions. Gradually increase the restrictions, and monitor the speed of the pump closely, to make sure not to over-run the pump**
- **The operation can make the pump runs at very high speed. You should test your system for safety under all potential conditions. Failure to do so can result in damage to the equipment and/or serious injury to personnel**

Feedback Control by Using a Flowmeter with 4-20 (mA) Signal

1. Preliminary Action:

- A flowmeter which can send 4-20 (mA) flow signal to ZeDrive
- Max. Flowrate — F_m (cc/min) (or in other units. Find out from the flowmeter)

2. Calculation:

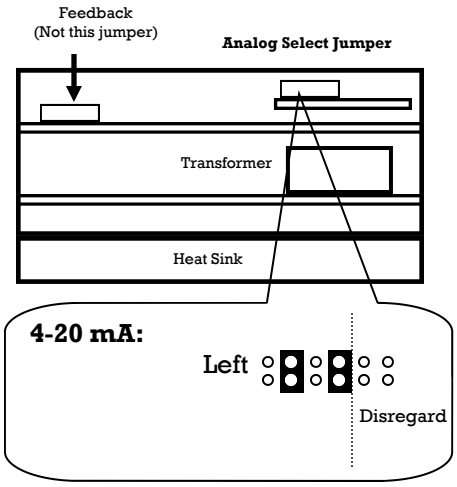
None

3. Coding:

Check and change the following codes

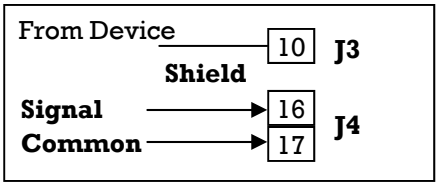
Code 20 = F_m
Code 22 = F_m
Code 61 = 1
Code 63 = 1
Code 84 = 2

Analog Select Jumper Location



4. Wiring:

- Locate Analog Select Jumpers on "Control Board":
  1. Loosen up 6 screws on the back panel, and 2 screws located on the heat sink of ZeDrive
  2. Remove the back panel. Face the back of Ze-Drive and place ZeDrive so that the heat sink points down. The top board is the "Control Board", and the bottom one is "Drive Board"
  3. Locate Feedback Jumper as shown at left
  4. Please check the jumper settings as shown at the left, and make changes as necessary
- Connect the wires from the flowmeter as shown at left
- Leave anything else unchanged as before



5. Result:

- The output from the pump will be controlled by the flowmeter
- The units of the setpoint and the Tach are same as the unit of F_m

6. IMPORTANT NOTE:

- **The unit is no longer in (RPM). It is in the engineering unit, same as F_m**
- **The pump speed may vary widely. Do not to exceed the factory suggested speed limit**
- **Any restriction at the discharge side of the pump can rapidly increase the pump speed.** Check any down-stream restrictions before the operation
- **Always test the system without any down-stream restrictions. Gradually increase the restrictions, and monitor the pump speed closely, make sure not to over-run the pump**
- **You should test your system for safety under all potential conditions. Failure to do so can result in damage to the equipment and/or serious injury to personnel**

Feedback Control by Using a Flowmeter with 0-10 (VDC) Signal

1. Preliminary Action:

- A flowmeter which can send 0-10 (VDC) flow signal to ZeDrive
- Max. Flowrate — F_m (cc/min) (or in other units. Find out from the flowmeter)

2. Calculation:

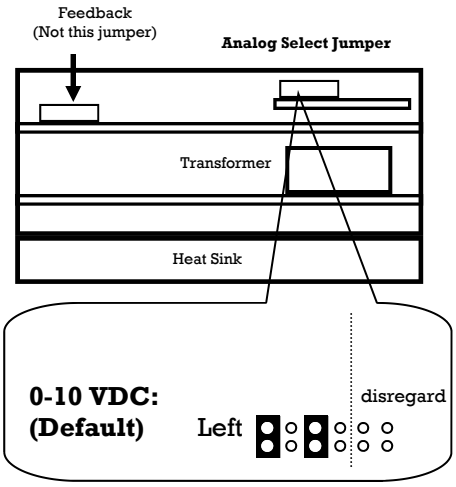
None

3. Coding:

Check and change the following codes

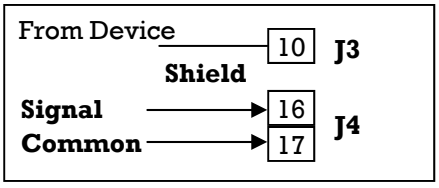
Code 20 = F_m
Code 22 = F_m
Code 61 = 1
Code 63 = 1
Code 84 = 2

Analog Select Jumper Location



4. Wiring:

- Locate Analog Select Jumpers on "Control Board":
  1. Loosen up 6 screws on the back panel, and 2 screws located on the heat sink of ZeDrive
  2. Remove the back panel. Face the back of Ze-Drive and place ZeDrive so that the heat sink points down. The top board is the "Control Board", and the bottom one is "Drive Board"
  3. Locate Feedback Jumper as shown at left
  4. Please check the jumper settings as shown at the left, and make changes as necessary
- Connect the wires from the flowmeter as shown at left:
- Leave anything else unchanged as before



5. Result:

- The output from the pump will be controlled by the flowmeter
- The units of the setpoint and the Tach are same as the unit of F_m

6. IMPORTANT NOTE:

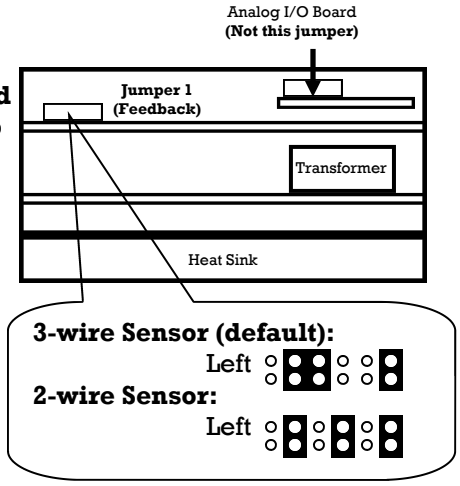
- **The unit is no longer in (RPM). It is in the engineering unit, same as F_m**
- **The pump speed may vary widely. Do not to exceed the factory suggested speed limit**
- **Any restriction at the discharge side of the pump can rapidly increase the pump speed.** Check any down-stream restrictions before the operation
- **Always test the system without any down-stream restrictions. Gradually increase the restrictions, and monitor the pump speed closely, make sure not to over-run the pump**
- **You should test your system for safety under all potential conditions. Failure to do so can result in damage to the equipment and/or serious injury to personnel**

Master/Follower System

1. Preliminary Action:

- Two individual ZeDrive systems are needed for forming a master/follower system
- **The following is only one example. For more detailed system integration and configuration, please refer to Chapter 5 in "ZeDrive and ZeTrol Manual"**
- Master Reducer Gear Ratio — R_m. If the pump is directly coupled with the motor, the gear ratio R_m=1
- Follower Reducer Gear Ratio — R_f. If the pump is directly coupled with the motor, the gear ratio R_f=1
- Motor maximum speed — V_M (RPM), usually, 1800 (RPM)
- Master Pump Capacity — C_m (cc/rev)
- Follower Pump Capacity — C_f (cc/rev)
- Master Feedback Sensor Resolution — F_m (No. of Teeth)
- Follower Feedback Sensor Resolution — F_f (No. of Teeth)

Feedback Jumper Location



2. Calculation:

2.1 Master Primary Setpoint — P_m (cc/min)

P_m (cc/min) = V_M (RPM) / R_m × C_m (cc/rev)

2.2 Maximum Percent between Follower and Master — P_f (%)

P_f (%) = Follower Max. Flowrate (cc/min) / Master Max. Flowrate (cc/min)

= [V_M (RPM) / R_f × C_f (cc/rev)] / [V_M (RPM) / R_m × C_m (cc/rev)]

= [R_m / R_f] × [C_f / C_m]

3. Coding:

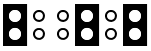
Check and change the following codes

	For Master	For Follower
Primary Setpoint, Eng. Unit	Code 20 = P_m	Code 20 = P_f
Primary Display, Eng. Unit	Code 22 = P_m	Code 22 = P_f
External Ref. Resolution, PPR		Code 30 = F_m
Feedback Resolution, PPR	Code 31 = F_m	Code 31 = F_f
Primary Max. External Ref. Speed, RPM		Code 33 = V_M
Primary Max. Feedback Speed, RPM	Code 34 = V_M	Code 34 = V_M
Primary Scaling Format	Code 61 = 1 (Master)	Code 61 = 2 (Follower)
Primary Display Format	Code 63 = 1 (Master)	Code 63 = 2 (Follower)

Master/Follower System (cont'd)

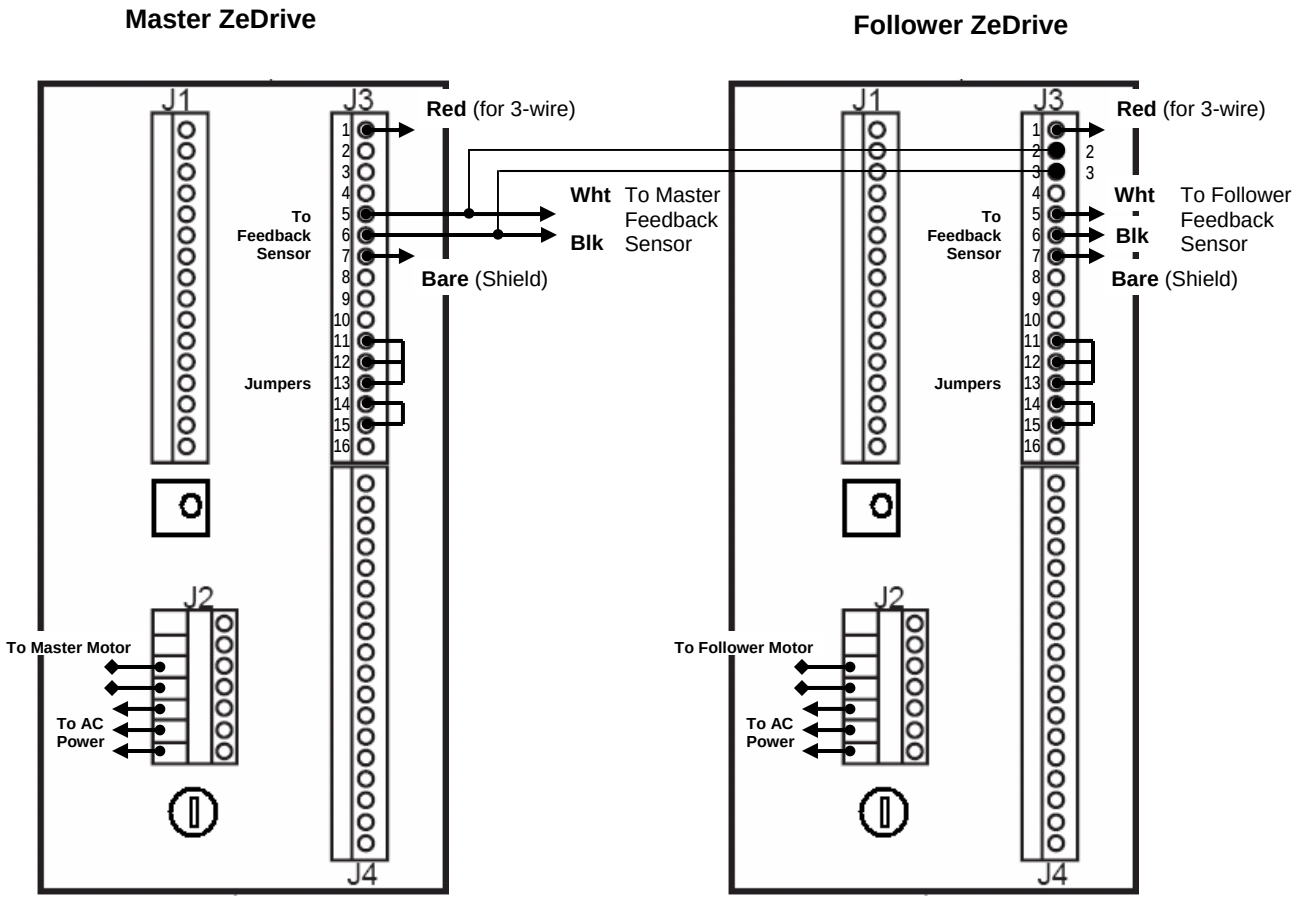
4. Wiring:

- Make sure the feedback jumper settings are correct and matched to the feedback sensors of master and follower systems

Master	Follower	Jumper Settings
3-wire	3-wire	left
3-wire	2-wire	left 
2-wire	2-wire	left
2-wire	3-wire	left

NOTE: Do not count bare wire (shield wire)

- Connect wires like the following illustration to form a master/follower system (for detailed connection, please refer to page G-4 in "ZeDrive and ZeTrol Manual"



Master/Follower System (cont'd)

5. Result:

- Turn on the AC power for both systems
- Input Follower Primary Setpoint 1 (Code 01), i.e., 75 (%)
- Input Master Primary Setpoint 1 (Code 01), i.e., 20 (cc/min)
- The master system should run, and the follower system should run and deliver 75% the flowrate the master system delivers
- Stop the master system, the follower will also stop

6. IMPORTANT NOTE:

- **The above master/follower system is only a simplest example. For more detailed system integration and configuration, please refer to Chapter 5 in "ZeDrive and ZeTrol Manual"**

Adjust Current Output Limit

NOTE:

The current limit level on ZeDrive is adjustable from approximately 4 to 16 amps.

The current limit is not operable when ZeDrive is in Direct Scaling Mode (Code 61 = 0).

1. Preliminary Action:

- An AC Ammeter
- A Screw Driver

2. Procedures:

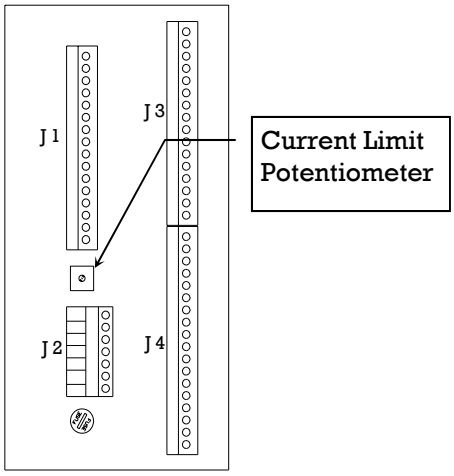
2.1 Place the AC ammeter in series (or clamp on) with one of the VAC power input lines L1 or L2/Neutral

2.2 Turn the current limit potentiometer at the rear of ZeDrive fully clockwise.

2.3 With ZeDrive in the RUN state, gradually increase the load until the AC ammeter reaches the desired limit level

2.4 Turn the current limit potentiometer counter-clockwise until ZeDrive begins to current limit. This is exhibited by the following conditions:

- A Slight reduction in motor RPM
- The front panel "LIMIT ALARM" LED illuminates
- Code 52 indicates a value of 7



2.5 Increase the motor load gradually. The load current should not increase and the motor RPM should decrease

Calibrate Analog Input

NOTE:

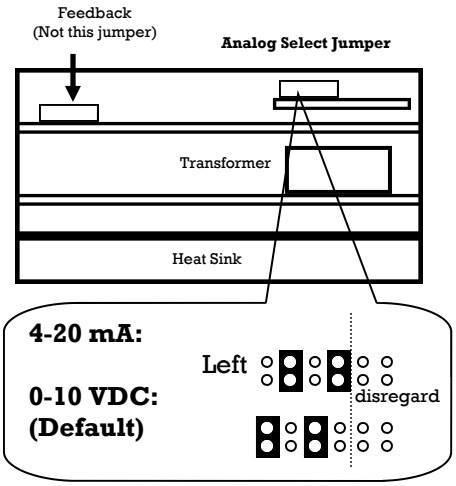
In most instances, ZeDrive™ 2000 will come to you prepackaged in a control cabinet. The controller will be mounted and all internal cabinet wiring will be complete.

The unit will also be programmed according to your specifications. The analog inputs and output will have been calibrated for 4-20mA, unless otherwise specified. If re-calibration is desired for some reason, such as using 0-10V signals, instead of 4-20mA, follow the appropriate procedure below.

1. Preliminary Action:

- External device which supplies 0-10 (VDC) or 4-20 (mA) calibration signal to ZeDrive
- Locate Analog Select Jumpers on "Control Board":
    1. Loosen up 6 screws on the back panel, and 2 screws located on the heat sink of ZeDrive
    2. Remove the back panel, place ZeDrive as shown at left. The top board is the "Control Board", and the bottom one is "Drive Board"
    3. Locate Analog Select Jumper as shown at left
    4. Depend on the signal, change the jumper setting as shown at the left

Analog Select Jumper Location



2. Procedures:

2.1 Connect the analog calibration input source to J4-16(+) and J4-17 (-)

2.2 Select code C-85

2.3 Inject a "zero" signal (4mA or 0V)

2.4 Press the "." button

2.5 Select code C-86

2.6 Inject a "span" signal (20mA or 10V)

2.7 Press the "." button

Calibrate Analog Output

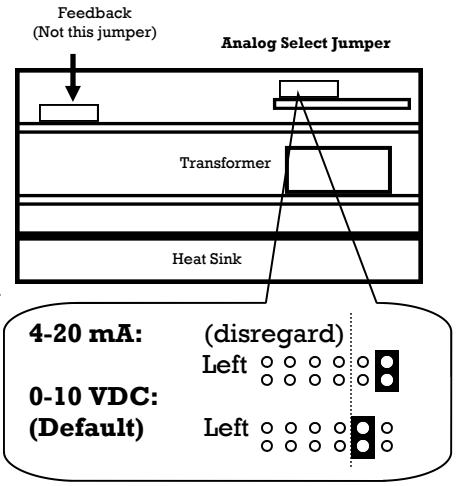
NOTE:

In most instances, ZeDrive™ 2000 will come to you prepackaged in a control cabinet. The controller will be mounted and all internal cabinet wiring will be complete.
The unit will also be programmed according to your specifications. The analog inputs and output will have been calibrated for 4-20mA, unless otherwise specified. If re-calibration is desired for some reason, such as using 0-10V signals, instead of 4-20mA, follow the appropriate procedure below.

1. Preliminary Action:

- External device which can measure 0-10 (VDC) or 4-20 (mA) analog signal, i.e., a multi-meter
- Locate Analog Select Jumpers on "Control Board":
    1. Loosen up 6 screws on the back panel, and 2 screws located on the heat sink of ZeDrive
    2. Remove the back panel, place ZeDrive as shown at left. The top board is the "Control Board", and the bottom one is "Drive Board"
    3. Locate Analog Select Jumper as shown at left
    4. Depend on the signal, change the jumper setting as shown at the left

Analog Select Jumper Location



2. Procedures:

2.1 Connect the analog calibration measuring device to J4-18(+) and J4-17 (-)

2.2 Select code C-82

2.3 Change the value in code C-82 until the measuring device reads "zero" (4mA or 0V)

2.4 Select code C-83

2.5 Change the value in code C-83 until the measuring device reads "span" (20mA or 10V)

Trouble-shooting & Fault Information

Trouble-shooting & Common Questions

1. Good Sensor or Bad Sensor:

It is a good practice to always perform this step before proceed to any trouble-shooting.

- Use a voltmeter to measure DC voltage between VP and DCM on PG-02 card of ZeDrive drive.
- If a Hall Effect sensor is used, make sure TSW2 switch points to 12V location (up location). The reading should be about 12 (VDC). If the reading is small or it is always 0V, it may indicate a defected PG-02 card. Replace another card to verify again. If the reading is correct, proceed the following steps.
- Disconnect the power, and connect the sensor wires to PG-02 card (or, use a separate 12VDC power supply), and turn the power back on
- Measure DC voltage between A (signal wire) and DCM on PG-02 card inside of ZeDrive drive
- Slowly turn the motor shaft (or reducer shaft) by using a wrench, the voltage should vary between 0 (VDC) and 12 (VDC). If the shaft is turned fast, the voltage may stay at about 6 (VDC) level.
- If the voltage always stay at 0 (VDC), or any value below 1 (VDC), please check the sensor wiring. If the wiring is correct, it may be a defected sensor. Please contact Zenith for a replaced one
- If the voltage is always above 12 (VDC), when the shaft is turning, please check the sensor wiring. If the wiring is correct, it may be a defected sensor. Please contact Zenith for a replaced one
- If the voltage varies between 0 (VDC) and 12 (VDC), or it stays at 6 (VDC), it indicates that the sensor is good. Please proceed to the proper section for further trouble-shooting

2. No Feedback Signal:

Please follow Step 5 of "Quick Test for ZeDrive" to manually verify the feedback signal.

- The gap between the feedback sensor and the pickup gear inside of reducer should be 0.005", without any interference. To do this, the simplest method is:

  Screw the sensor into the thread hole located on the gear reducer, until it hits the inside pickup gear, and back up about 1/8 of a turn (45 degrees)

- The wiring for the sensor is incorrect

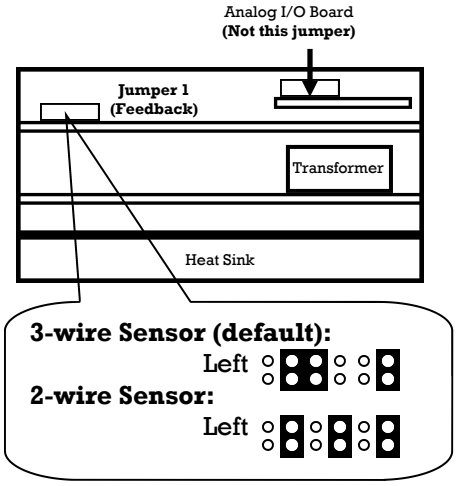
  If it is a 2-wire sensor, connect
  White wire - J3 Pin 5
  Black wire - J3 Pin 6
  Bare wire - J3 Pin 7

  If it is a 3-wire sensor, connect
  Red wire - J3 Pin 1
  White wire - J3 Pin 5
  Black wire - J3 Pin 6
  Bare wire - J3 Pin 7

Trouble-shooting & Common Questions

- 12 VDC power is not correct when a 3-wire sensor is used. Measure J3 connector Pin 1 to Pin 12 by a multi-meter, make sure it is 12 VDC
- Feedback jumper settings on "Control Board" do not match the feedback sensor you have on hand. Check and change the jumper settings on the "Control Board":
    1. Loosen up 6 screws on the back panel, and 2 screws located on the heat sink of ZeDrive
    2. Remove the back panel. Face the back of Ze-Drive and place ZeDrive so that the heat sink points down
    3. There are 2 boards inside of ZeDrive. When you place ZeDrive as shown in step 2, the top board is the "Control Board", and the bottom one is "Drive Board"
    4. Locate Feedback Jumper as shown at left
    5. Depend the type of sensor you have, please check the feedback jumper settings as shown at the left

Feedback Jumper Location



3. System Always Runs at Full Speed:

Refer to 2—"No Feedback Signal"

4. System Can Not Run Below 30 RPM or 40 RPM:

Refer to 2—"No Feedback Signal"

5. System Never Runs:

- Check the jumpers on J3 connector
  Pin 11 - Pin 12
  Pin 13 - Pin 12
  Pin 14 - Pin 15
- The 2 power fuses located on the "Drive Board" are blown out. To locate "Drive Board", please refer to 1—"No Feedback Signal"

6. System Can Not Run up to Max. Speed:

- Check Code 11 for the max. speed limit of the motor (typically 1800 rpm)

7. System Can Not Run Slow Enough:

- Check Code 10 for the min. speed limit of the motor (typically 0 rpm)

8. System Speed Does Not Match Set Speed:

- Verify the values for the following codes:

  Code 61 = 1 ("Primary Active Output Format" set to "Master")
  Code 20 = 1800 / Gear Ratio (Maximum Reducer Speed in RPM)

Trouble-shooting & Common Questions (cont'd)

Code 31 = No. of Teeth of the Pickup Gear (Feedback Reference Resolution)
Code 34 = 1800 (Maximum Motor Speed, typically 1800 RPM)

- After the above step, the unit of the set point should be in RPM of the reducer shaft
- Run the system, and verify the speed of the reducer shaft
- If the actual speed of the reducer shaft does not match the set point, please verify, calculate and change the values of the above codes

9. System Needs Help to Start to Rotate:

- Connect only A1 and A2 terminals on DC motor to ZeDrive A1 and A2 terminals, respectively. Leave F1 and F2 terminals unconnected
- If a shunt motor is used, check the wiring diagram

10. System Turns at Wrong Direction:

- Swap A1 and A2 wires should change the direction

11. It Takes Very Long Time to Ramp Up:

- Check Code 16 for acceleration time
- Smaller the value, lesser the time for the motor to ramp up. However, it may increase the chance to damage the pump, due to the quick pressure build-up caused by the restriction down the stream of the pump

12. It Takes Very Long Time to Slow Down or Stop:

- Check Code 17 for deceleration time
- Smaller the value, lesser the time for the motor to stop.

13. Simple Way to Verify Feedback Signal:

- Power up ZeDrive
- Click TACH button
- Turn the reducer shaft by a wrench
- Non-zero number should be shown on the top display, whenever the shaft turns

If there always is "0" on the top display, something is wrong related to feedback. Please refer to "Trouble-shooting" section

14. Tach Reads Incorrectly:

- Verify the values for the following codes:

Code 61 = 1 ("Primary Active Output Format" set to "Master")
Code 20 = 1800 / Gear Ratio (Maximum Reducer Speed in RPM)
Code 22 = 1800 / Gear Ratio (Maximum Reducer Speed Display in RPM)
Code 31 = No. of Teeth of the Pickup Gear (Feedback Reference Resolution)
Code 34 = 1800 (Maximum Motor Speed, typically 1800 RPM)

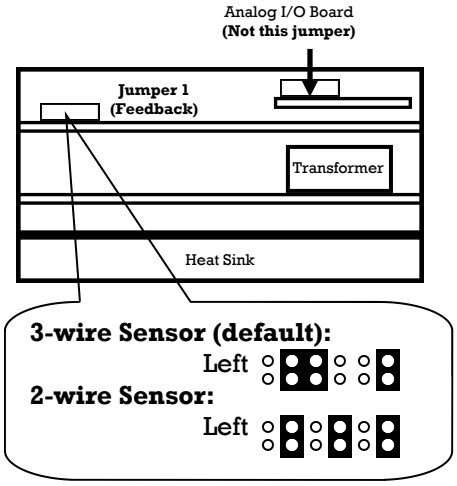
Trouble-shooting & Common Questions (cont'd)

15. Replaced Feedback Sensor Fits the Existing ZeDrive Or Not:

Feedback jumper settings on "Control Board" should match the sensor you have on hand. Check and change the jumper settings on the "Control Board":

1. Loosen up 6 screws on the back panel, and 2 screws located on the heat sink of ZeDrive
2. Remove the back panel. Face the back of Ze-Drive and place ZeDrive so that the heat sink points down
3. When you place ZeDrive as shown in step 2, the top board is the "Control Board", and the bottom one is "Drive Board"
4. Locate Feedback Jumper as shown at left
5. Check the feedback jumper settings as shown at the left

Feedback Jumper Location



16. Display Shows "- - - 1", "- - - 2"or "- - - 3":

- If the AC power setting of ZeDrive sets to 230 VAC (refer to 12 of this section), it may indicate that the actual AC power is 120 VAC
- It may also indicate an environment problem, such as electrical noise severe enough to disrupt the microprocessor. Generally,

  "- - - 1" indicates incompatible AC power
  "- - - 2" indicates electrical noise problem
  "- - - 3" indicates parameter storage area has been corrupted

- If "- - - 2" or "- - - 3" appears, the programming control parameters should be verified and restoration back to factory settings may be performed (refer to 16 of this section)

17. Restore Back to Factory Defaults:

- Make sure copy down the original settings, especially the values for the following codes:

Code 1 - Primary Setpoint 1
Code 8 - Feedback Input Select
Code 10 - Minimum Limit
Code 11 - Maximum Limit
Code 12 - Low Alarm
Code 13 - High Alarm
Code 16 - Acceleration Time
Code 17 - Deceleration Time
Code 20 - Maximum Primary Setpoint
Code 21 - Maximum Secondary Setpoint
Code 22 - Maximum Primary Display
Code 23 - Maximum Secondary Display
Code 31 - No. of Teeth of the Feedback Pickup Gear
Code 34 - Maximum Motor Speed (Primary)
Code 37 - Maximum Motor Speed (Secondary)
Code 61 - Primary Active Output Format Selection
Code 62 - Secondary Active Output Format Selection
Code 63 - Primary Active Display Format Selection
Code 64 - Secondary Active Display Format Selection
Code 84 - Analog Input Function Selection
Code 85 - Analog Input Zero

Trouble-shooting & Common Questions (cont'd)

- Turn off the AC power for ZeDrive
- Press down "CLEAR" button and "7" button at same time, and hold
- Apply AC power to ZeDrive
- Release the above 2 buttons, until ZeDrive powers up
- Restore the values for above codes

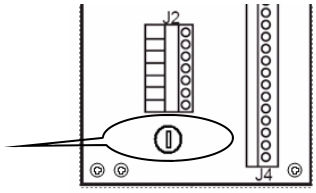
NOTE: Make sure to back up the original settings for your system. Once you perform this step, all settings will be restore to factory default values. The defaults may NOT match the actual system you have.

18. Can Not Operate from Keypad:

- ZeDrive could be set for Analog Remote Control mode
- To use keypad on ZeDrive to control the system, set the value of Code 84 to 0

19. The Display Would Not Light Up:

- Turn off the AC power of ZeDrive
- Check the fuse located below J2 connector on the back panel, and replace it as necessary



20. How Do I Use ZeDrive for 230 (VAC) Power:

- Locate the "Drive Board" inside of ZeDrive. Please refer to section "No Feedback Signal"
- There is a "Power Selection Switch" on the "Drive Board". Flip the switch so that it shows "230 VAC" (by default, ZeDrive sets to "120 VAC")

Fault Code List

Code	Fault Description	Corrective Actions
10	LIMIT alarm LED lights up	This parameter establishes the minimum level of motor RPM during operation. It is allowable to program a set-point which is below this value, however the controller will enforce this minimum speed (measured at the motor shaft)
11	LIMIT alarm LED lights up	This parameter establishes the maximum level of motor RPM during operation. It is allowable to program a set-point which is above this value, however the controller will enforce this maximum speed (measured at the motor shaft)
12	LIMIT alarm LED lights up	This parameter establishes the point at which the LO-ALARM output is turned on
13	LIMIT alarm LED lights up	This parameter establishes the point at which the HI-ALARM output is turned on
14	Deviation alarm LED lights up	Ramped Error Alarm establishes the error band (defined as ramped motor speed minus actual motor speed) at which DEV ALARM output is turned on. If the difference between actual motor speed and ramped desired motor speed is greater than or equal to C-14, the alarm is turned on.
15	Deviation alarm LED lights up	Scaled Error Alarm establishes the error band (defined as final motor speed minus actual motor speed) at which DEV ALARM output is turned on. If the difference between actual motor speed and final desired motor speed is greater than or equal to C-15, the alarm is turned on

Complete Code List

C01	**Primary Setpoint 1**	Default: 0
C02	**Primary Setpoint 2**	Default: 0
C03	**Secondary Setpoint 1**	Default: 0
C04	**Secondary Setpoint 2**	Default: 0

Units: eng

Range: 0.000~9999

These codes have differing meanings, depending on the output format selected. They are always in Engineering Units.

The back-panel switch inputs or remote serial interface will select one of the four setpoints.

- Direct output format: C01 through C04 are not used
- Master output format: Absolute setpoint
- Follower output format: Multiplier ratio
- Offset output format: Multiplier ratio

C05	**Jog Setpoint**	Default: 50

Units: Motor RPM

Range: 0~9999

This parameter establishes the speed at which the motor rotates during a JOG operation. It is always measured at the drive motor shaft.

C06	**Output Setpoint**	Default: 0

Units: % (of Armature Voltage)

Range: 0~100

This parameter controls the power level applied to motor only when Direct Output Format is selected. Units are in percent and refer to the percent of input waveform that is rectified and applied to the motor (100% means the full rectified AC line voltage is applied to motor).

Note: The percent of input power required to drive a motor at a given speed varies according to load and that full motor speed is achieved at a setpoint of much less than 100%.

C10	**Minimum Limit**	Default: 0

Units: Motor RPM

Range: 0~9999

This parameter establishes the minimum level of motor RPM during operation. It is allowable to program a setpoint which is below this value, however the controller will enforce this minimum speed (measured at the motor shaft), except when attempting to recover position error.

11 Maximum Limit Default: 1800

Units: Motor RPM

Range: 0~9999

This parameter establishes the maximum level of motor RPM during operation. It is allowable to program a setpoint which is above this value, however the controller will enforce this maximum speed (measured at the motor shaft), except when attempting to recover position error.

12 Low Alarm Default: 0

Units: Motor RPM

Range: 0~9999

This parameter establishes the level of motor RPM during operation below which the LO-ALARM output is turned on.

13 High Alarm Default: 1800

Units: Motor RPM

Range: 0~9999

This parameter establishes the level of motor RPM during operation above which the HI-ALARM output is turned on.

14 Ramped Error Alarm Default: 1800

Units: Motor RPM

Range: 0~9999

This parameter establishes the error band (defined as Ramped Speed minus actual speed) at which DEV-ALARM output is turned on. If the difference between actual speed and ramped desired speed is greater than or equal to C14, the alarm is turned on.

15 Scaled Error Alarm Default: 1800

Units: Motor RPM

Range: 0~9999

This parameter establishes the error band (defined as Final Speed minus actual speed) at which DEV ALARM output is turned on. If the difference between actual speed and final desired speed is greater than or equal to C15, the alarm is turned on.

16 Acceleration Time Default: 600.0

17 Deceleration Time Default: 600.0

Units: Seconds

Range: 0.0~600.0

These parameters control the rate at which the desired speed is ramped up/down. It is the number of seconds required to change the motor speed by 1800 RPM. Default value of 600 seconds assures proper lubrication of a new pump. After the initial startup period, operating values can be much lower.
Acc. Time below 0.5 second are not recommended

18 Lag Pulse Limit Default: 0

Units: Number of Pulses

Range: 0~9999

It sets a maximum pulse error count for the difference between idealized feedback pulses minus the Feedback pulses. It may not always be desirable to recover all the position error lag. Set this paramter to the desired lag pulse limit.

19 Lead Pulse Limit Default: 0

Units: Number of Pulses

Range: 0~9999

It sets a maximum pulse error count when the Feedback pulses exceed the idealized feedback pulse count. Set this parameter to the desired lead pulse limit.

20 Primary Setpoint Maximum Default: 1800

Units: eng

Range: 0~9999

This parameter establishes full-scale speed when one of the primary setpoints is active. It is in the same units as C01 and C02. The format of the number entered here (number of digits to the right of decimal point) establishes the setpoint format. When the controlled process is at this speed, the Motor Shaft Speed will be at C34 (Max RPM Feedback - Primary)

21 Secondary Setpoint Maximum Default: 1800

Units: eng

Range: 0~9999

This parameter establishes full-scale speed when one of the secondary setpoints is active. It is in the same units as C03 and C04. The format of the number entered here (number of digits to the right of decimal point) establishes the setpoint format. When the controlled process is at this speed, the Motor Shaft Speed will be at C37 (Max RPM Feedback - Secondary)

22 Primary Display Maximum Default: 1800

Units: eng

Range: 0~9999

This parameter is similar to C20, but will be used for display, thus allowing a scale factor to be introduced between the controlled process and the display. The format of the number entered here (number of digits to the right of decimal point) will be used for the speed display. This parameter is used when one of the primary setpoints is active.

23 Secondary Display Maximum Default: 1800

Units: eng

Range: 0~9999

This parameter is similar to C22, but will be used for display, thus allowing a scale factor to be introduced between the controlled process and the display. The format of the number entered here (number of digits to the right of decimal point) will be used for the speed display. This parameter is used when one of the secondary setpoints is active.

29 Recovery Multiplier Default: 0.0

Units:

Range: 0.0~100.0

It determines the rate at which the pulse error is reduced to zero. This parameter multiplied by the pulse error count is the number by which the speed setpoint is adjusted every 100 milliseconds.

30 External Reference PPR Default: 120

Units: PPR (Number of Pulses Per Revolution)

Range: 0~3270

It is the number of pulses generated by the device attached to External Reference Input for each revolution of its shaft.

31 Feedback Reference PPR Default: 120

Units: PPR (Number of Pulses Per Revolution)

Range: 0~3270

It is the number of pulses per revolution generated by the device attached to Motor Shaft.

32 Auxiliary Input PPR Default: 120

Units: PPR (Number of Pulses Per Revolution)

Range: 0~3270

It is the number of pulses generated by the device attached to Auxiliary/Offset Frequency Input for each revolution of its shaft.

33 Max RPM External Reference - Primary Default: 1800

Units: PPR (Number of Pulses Per Revolution)

Range: 0~3270

It sets the full-scale speed of the device driving External Reference, and is used in Follower or Offset formats when the primary data set is selected.

34 Max RPM Feedback - Primary Default: 1800

Units: PPR (Number of Pulses Per Revolution)

Range: 0~3270

It sets the full-scale speed of the motor. When the motor is turning at this speed with a primary setpoint selected, the controlled process will be at C20 (Primary Setpoint Maximum).

35 Max RPM Aux / Offset - Primary Default: 1800

Units: PPR (Number of Pulses Per Revolution)

Range: 0~3270

It sets the full-scale speed of the device driving the Auxiliary / Offset frequency input, and is used in the Offset format when the primary data set is selected.

36 Max RPM External Reference - Secondary Default: 1800

Units: PPR (Number of Pulses Per Revolution)

Range: 0~3270

It sets the full-scale speed of the device driving External Reference, and is used in Follower or Offset formats when the secondary data set is selected.

37 Max RPM Feedback - Secondary Default: 1800

Units: PPR (Number of Pulses Per Revolution)

Range: 0~3270

It sets the full-scale speed of the motor. When the motor is turning at this speed with a secondary setpoint selected, the controlled process will be at C21 (Secondary Setpoint Maximum).

38 Max RPM Aux / Offset - Secondary Default: 1800

Units: PPR (Number of Pulses Per Revolution)

Range: 0~3270

It sets the full-scale speed of the device driving the Auxiliary / Offset frequency input, and is used in the Offset format when the secondary data set is selected.

M40 Tachometer — Read Only

Units: eng

Range:

It is the feedback displayed in scaled Engineering Units. The feedback input is read by ZeDrive every 10 milliseconds. The readings are summed and averaged for one second before displaying

M41 External Reference Input — Read Only

Units: Hz

Range:

It displays the frequency of External Reference Input in hertz (pulses per second). The number displayed is not averaged. It represents the frequency calculation from the prior 10 milliseconds before the display update. Because it is not averaged over the display update period, it appears less stable than Tachometer display due to sensor irregularities or other system dynamic errors.

It may contain numbers larger than 9999. When this occurs, the value is displayed differently. For example, a "10.00." display indicates 10,000 Hz.

M42 Auxiliary / Offset Frequency Input — Read Only

Units: Hz

Range:

It displays the frequency of Auxiliary/Offset Frequency Input in hertz (pulses per second). The number displayed is not averaged. It represents the frequency calculation from the prior 10 milliseconds before the display update. Because it is not averaged over the display update period, it appears less stable than Tachometer display due to sensor irregularities or other system dynamic errors.

It may contain numbers larger than 9999. When this occurs, the value is displayed differently. For example, a "10.00." display indicates 10,000 Hz.

M43 Feedback Frequency Input — Read Only

Units: Hz

Range:

It displays the frequency of Feedback Frequency Input in hertz (pulses per second). The number displayed is not averaged. It represents the frequency calculation from the prior 10 milliseconds before the display update. Because it is not averaged over the display update period, it appears less stable than Tachometer display due to sensor irregularities or other system dynamic errors.
It may contain numbers larger than 9999. When this occurs, the value is displayed differently. For example, a "10.00." display indicates 10,000 Hz.

M44 Deviation (Error) — Read Only

Units: Hz

Range:

It shows the difference between the desired speed and actual speed of the machine.

M45 Scaled Reference — Read Only

Units: Hz

Range:

It is the desired speed of the controlled machine, expressed in Hz (assumed to be measured at the Feedback Frequency input). It is not altered by ramp-up or ramp-down. (In other words, this is the final destination, in terms of speed).

M46 Ramped Reference — Read Only

Units: Hz

Range:

It is the desired speed of the controlled machine, expressed in Hz (assumed to be measured at the Feedback Frequency input). It is altered by ramp-up or ramp-down. (In other words, this is the scaled reference adjusted for acceleration or deceleration as appropriate).

M50 Active Format — Read Only

Units:

Range:

0 Direct Format
1 Master Format
2 Follower Format
3 Offset Format

It is status indicator of the active scaling format

M51 Entry Error — Read Only

Units:

Range:

0 No Error
1 Invalid Code
2 Above Maximum Value
3 Below Minimum Value
4 Keypad Lockout
5 Entry Timeout

It shows the last error encountered on a keypad entry. If any entry is not accepted by the controller, the reason shows up here.

M52 Alarm Status — Read Only

Units:

Range:

1 Low Limit
2 High Limit
3 Low Alarm
4 High Alarm
5 Error Alarm 1
6 Error Alarm 2
7 Current Limit

It shows the status of limits and alarms in the controller.

M53 Control State — Read Only

Units:

Range:

1 JOG
32 RUN
64 Ramped Stop
128 Fast Stop

It shows the status of control state of the controller.

M54 Control Mode — Read Only

Units:

Range:

Bit 7 Primary (1) / Secondary (0) Data Set
Bit 6 Not used (was the forward /reverse flag on ZeTrol)
Bit 5 Closed-Loop (1) / Open-Loop (0)
Bit 4 Primary Setpoint 1 (1) / Primary Setpoint 2 (0)
Bit 3 Secondary Setpoint 3 (1) / Secondary Setpoint 4 (0)
Bit 2 Local (1) / Remote Serial (0) Control
Bit 1 Keypad Enable (1) / Disable (0)
Bit 0 Ramp Enable (1) / Disable (0)

It indicates the status of the optional switch inputs to the controller. It is a single-byte with meanings assigned to individual bits. This code, along with Code 53, is intended for use by computer interface.

M55 Analog Input 1 Raw Signal Read Only

Units: mA / VDC

Range:

It is Analog Input 1 signal unadjusted for Zero and Span.

M56 Analog Input 1 Adjusted Signal Read Only

Units: bits

Range:

It is Analog Input 1 signal adjusted for Zero and Span.

M57 Power Fail Count Read Only

Units: count

Range:

It represents the number of times that a power brownout condition was detected.
It is one of few monitoring codes which can be altered from keypad. When displayed, this number can be zeroed by pressing CLEAR key on keypad.

M58 Serial Communications Error Read Only

Units:

Range:

0 No Error
Bit 5 Data was out of minimum/maximum range
Bit 4 Invalid Parameter Code, Check Sum or Decial Point Error
Bit 3 Receive Buffer filled before ETX received or Message Format Error
Bit 2 Parity Error
Bit 1 Controller in Local Mode, Not in Computer Mode

It shows the status of the most recent data received from serial communications port.

60 Current Limit Response Default: 20

Units:

Range: 0~50

It defines how aggressively the software algorithm address the condition of current limit (i.e. how quickly the phase-angle firing is adjusted to reduce current).

61 Primary Scaling Format Default: 1

62 Secondary Scaling Format Default: 1

Units:

Range:

0 Direct
1 Master
2 Follower
3 Offset

These parameters select Output Format when primary and secondary data sets are selected, respectively.

64 Secondary Display Format

Default: 1

Units:

Range:

1 Master

2 Follower

These parameters are used to select Display Format used when primary and secondary data sets are selected, respectively.

65 Gain

Default: 5000

Units:

Range: 0~9999

This parameter sets Gain in PID control loop. This is the proportional part (P) of the equation. It is an integer number between 0 and 9999, with 0 being the special case of no Gain, but all other numbers being interpreted as follows: Larger numbers mean less Gain, smaller numbers mean more Gain.

66 Reset

Default: 500

Units:

Range: 0~9999

This parameter sets Reset in PID control loop. This is the integral part (I) of the equation. It is an integer number between 0 and 9999, with 0 being the special case of no Reset, but all other numbers being interpreted as follows: Larger numbers mean less Reset, smaller numbers mean more Reset.

67 Rate

Default: 9000

Units:

Range: 0~9999

This parameter sets Rate in PID control loop. This is the derivative part (D) of the equation. It is an integer number between 0 and 9999, with 0 being the special case of no Rate, but all other numbers being interpreted as follows: Larger numbers mean less Rate, smaller numbers mean more Rate.

68 Trim Authority

Default: 100

Units: %

Range: 0~100

This parameter scales the contribution of PID loop in setting the motor speed command (the remainder being supplied by the feed-forward term). This is an integer number between 0 and 100 (assumed to be percent), with 0 essentially keeping the PID from affecting anything.

69 Rate Threshold — Default: 5

Units: Hz

Range: 0~100

This parameter sets a threshold, below which the Rate term (derivative term) has no affect on PID control loop. In many cases, Rate is not needed, or is needed only when large, sudden errors in speed occur, and Rate Threshold allows a sort of selective use of the Rate term, if desired.

70 Device Address — Default: 1

Units:

Range: 1~32

It establishes the address for multi-drop communications. It is a number between 1 and 32. Each message transmitted from the remote serial device to the controller will contain an address field; only the addressed unit will respond to that message.

71 Baud Rate — Default: 1

Units:

Range:

1 300 bps
2 600 bps
3 1200 bps
4 2400 bps
5 4800 bps
6 9600 bps

It sets the link speed for remote serial communcations.

72 Character Format — Default: 3

Units:

Range:

1 7 Data Bits, No Parity, One Stop Bit (7-N-1)
2 7 Data Bits, Even Parity, One Stop Bit (7-E-1)
3 8 Data Bits, No Parity, One Stop Bit (8-N-1)

73 Serial Control Mask — Default: 0

Units:

Range:

Bit 7 Primary (1) / Secondary (0) Control Mode
Bit 6
Bit 5 Closed (1) / Open (0) Loop
Bit 4 Primary Setpoint Select (1)
Bit 3 Secondary Setpoint Select (1)
Bit 2 Run (1) / Stop (0)
Bit 1
Bit 0 Ramp Enable (1) / Disable (0)

It controls what functions are available to remote serial interface.

74	Zero Speed Logic	Default: 0

Units:

Range: 0~1

It dictates the operation of Zero-speed alarm output. If set to 0, the output is controlled only by the ramped reference (M-46); if set to 1, the output is controlled by both the ramped reference (M-46) and the feedback (M-43).

In other words,

If C74 = 0, ZERO SPEED output is HIGH whenever Ramped Reference (instantaneous desired speed) is zero and the output is LOW at all other times.

IF C74 = 1, ZERO SPEED output is LOW whenever Ramped Reference is non-zero, but does not go HIGH until both Ramped Reference and Feedback are BOTH zero.

75	Primary Positive Offset	Default: 0
76	Primary Negative Offset	Default: 0
77	Secondary Positive Offset	Default: 0
78	Secondary Negative Offset	Default: 0

Units: Hz

Range: 0~9999

These are positive and negative offset numbers for primary and secondary data sets. These allow the feedback to contain a bias. Only one (positive or negative) number can be non-zero at any given time.

79	Setpoint Mask	Default: 2

Units:

Range:

0 None setpoints disabled;

1 All setpoints disabled

2 Setpoint 2 and 4 disabled;

It determines which setpoints are disabled when keypad is locked out (J4, pins 1 and 2 shorted).

80	Analog Output Function	Default: 0

Units:

Range: 0~99

It assigns one M (Monitoring) or C (Control) code to the Analog Output signal. That variable will be routed (via firmware) to the digital-to-analog converter DAC and will thus show up on the Analog Output pins.

81 Analog Output Range Default: 4095

Units:

Range:

It establishes the value at which the analog output is 10VDC or 20 mA.

82 Analog Output ZERO Default: 1024

Units:

Range: 0~2048

It allows user to zero-adjust the analog output, as part of the calibration process.

83 Analog Output SPAN Default: 4095

Units:

Range: 2048~4096

It allows user to span-adjust the analog output, as part of the calibration process.

84 Analog Input Function Select Default: 0

Units:

Range:

0 Ananlog Input Not Used
1 Replace External Reference Frequency
2 Replace Feedback Frequency
3 Replace Offset Frequency
4 Replace Setpoint 1
5 Replace Setpoint 2
6 Replace Setpoint 3
7 Replace Setpoint 4

It allocates the Analog Input to the desired function.

85 Analog Input ZERO Default: 0

Units:

Range: 0~2048

It allows user to zero-adjust the analog input as part of the calibration process.

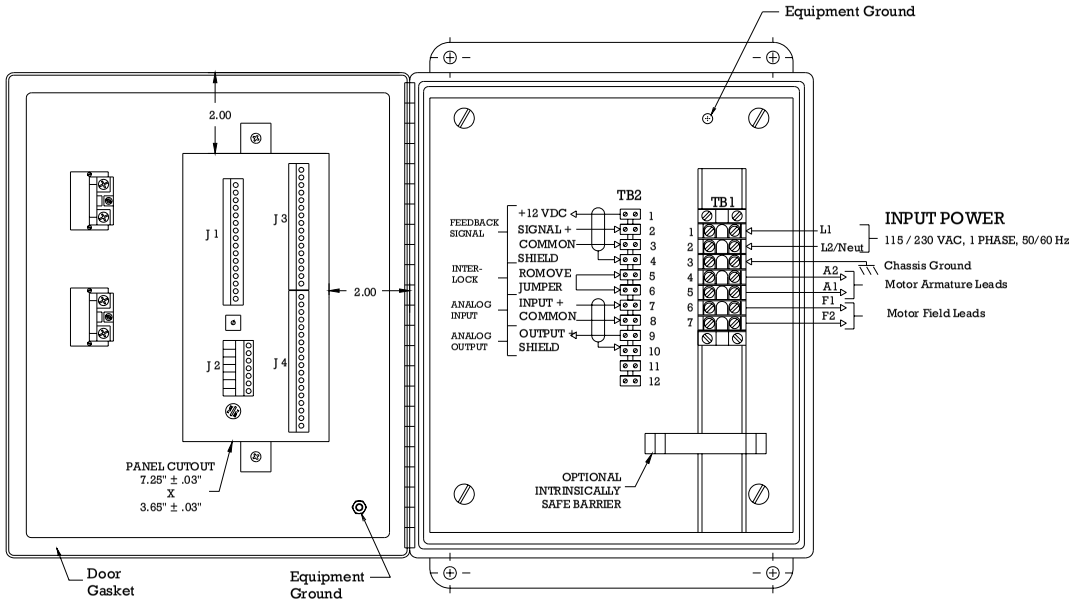
86 Analog Input SPAN Default: 3900

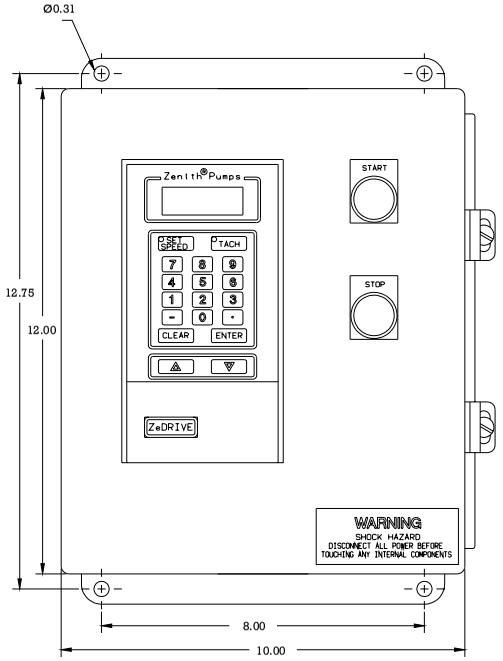
Units:

Range: 2048~4096

It allows user to span-adjust the analog input, as part of the calibration process.

System Drawings



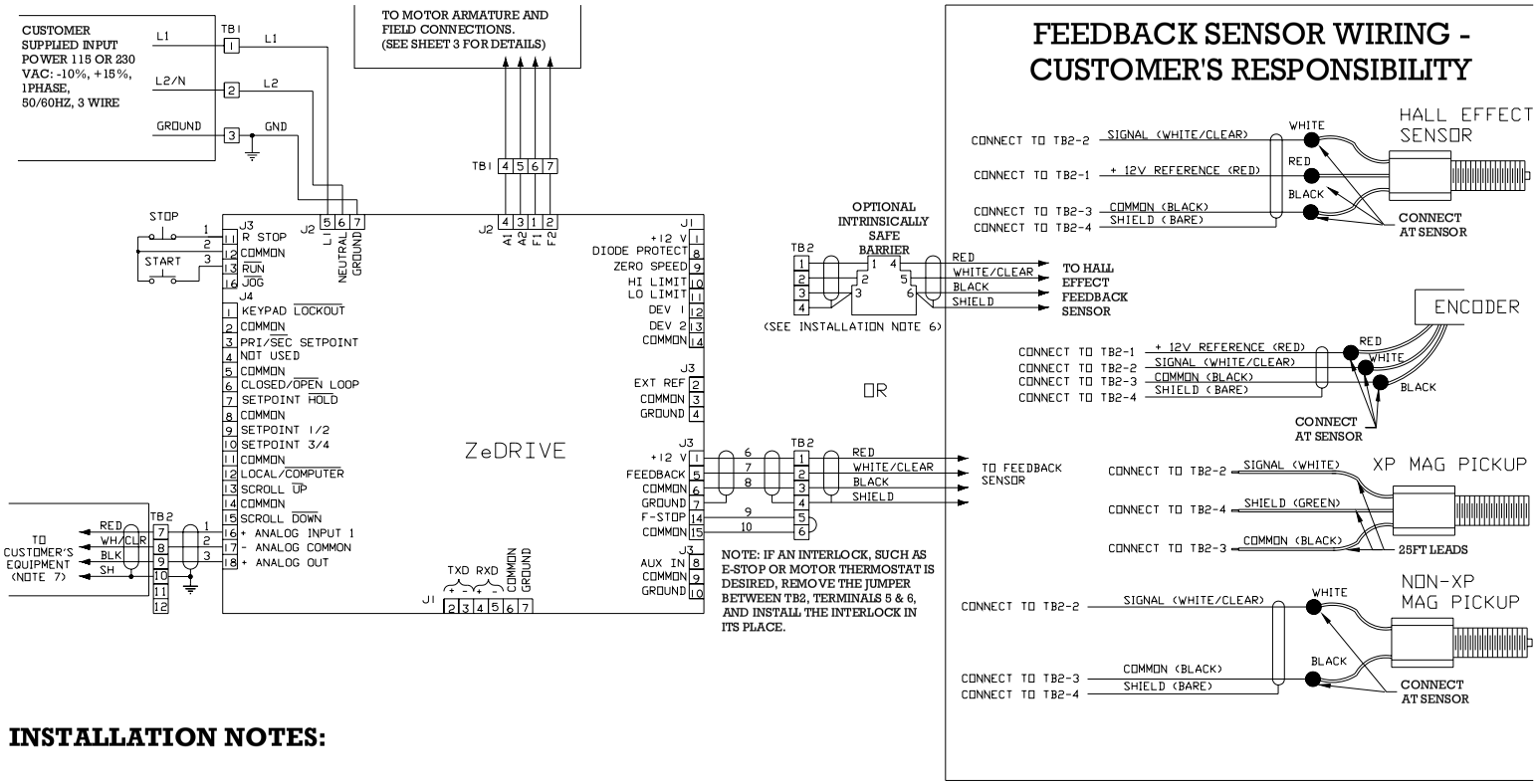


NOTES:

1. FOR INTERCONNECT WIRING BETWEEN ZeDRIVE AND TERMINAL STRIPS, REFER TO NEXT PAGE. INTERCONNECT WIRING TO BE INSULATED COPPER CONDUCTOR, RATED AT 600V, 90 DEGREES CENTIGRADE.
2. COMMON AND GROUND CONNECTIONS ON THE ZeDRIVE ARE OF DIFFERENT POTENTIAL. KEEP SEPARATE.
3. TERMINAL STRIPS ARE IEC TYPE.
4. NEMA 12 CABINET, 12"H X 10"W X 8"D.

NOTES:

MOTOR ARMATURE AND FIELD LEADS MUST BE RUN SEPERATE FROM SHIELDED SIGNAL CABLES TO AVOID SIGNAL NOISE IN FEEDBACK.



INSTALLATION NOTES:

1. ALL EXTERNAL WIRING, TERMINATING ON ONE OF ZeDRIVE LOGIC TERMINALS (J1, J3, OR J4), MUST BE IN SHIELDED CABLE. THE SHIELD MUST BE TERMINATED AT A ZeDRIVE GROUND ONLY (THE OPPOSITE END OF THE SHIELD IS NOT CONNECTED).
2. ROUTE SHIELDED CABLE SEPARATELY FROM POWER WIRING. DO NOT ROUTE 115VAC CONTROL WIRING AND LOW LEVEL SIGNAL WIRING IN THE SAME CONDUIT. DO NOT ROUTE FEEDBACK WIRING ALONG THE MOTOR CASE.
3. ALL GROUND CONNECTIONS MUST BE TRACEABLE TO A SINGLE TRUE EARTH GROUND.
4. USE ARC SUPPRESSORS ACROSS THE COILS OF ALL AC RELAYS AND CONTACTORS.
5. IN HIGH NOISE ENVIRONMENTS, INSTALL AN ISOLATION TRANSFORMER ON THE INPUT AC POWER.
6. WHEN USING A HALL EFFECT SENSOR OR ENCODER IN A HAZARDOUS ATMOSPHERE, THE OPTIONAL INTRINSICALLY SAFE BARRIER MUST BE USED.
7. REQUIRES OPTIONAL ANALOG I/O CARD, PART NO. 68-16818-0091-1.

NOTES:

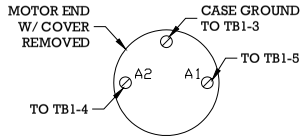
1. ALL FEEDBACK SENSORS ARE SUPPLIED WITH 25FT OF 2 OR 3 CONDUCTOR SHIELDED CABLE, AS APPROPRIATE (SHIPPED LOOSE).
2. ALL FEEDBACK SENSORS ARE LOCATED BETWEEN THE REDUCER AND THE MOTOR EXCEPT FOR THE ENCODER, WHICH IS LOCATED AT THE REAR OF THE MOTOR.

TO GET ASSISTANCE, CALL: 919-774-7667
ZENITH PUMPS

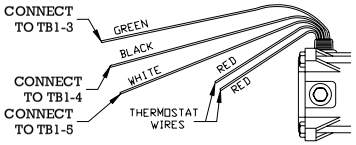
MOTOR ARMATURE AND FIELD WIRING - CUSTOMER'S RESPONSIBILITY

PERMANENT MAGNET MOTORS

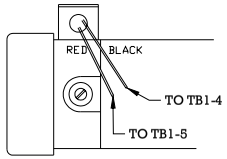
1/4 & 1/2 HP TENV & SEALED TIGHT (WASH DOWN) MOTORS



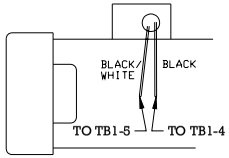
1/2 HP EXPLOSION PROOF MOTOR



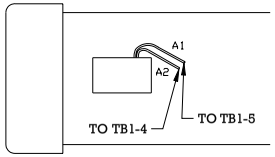
1 & 2 HP WASH DOWN MOTORS



1 HP TEFC MOTOR

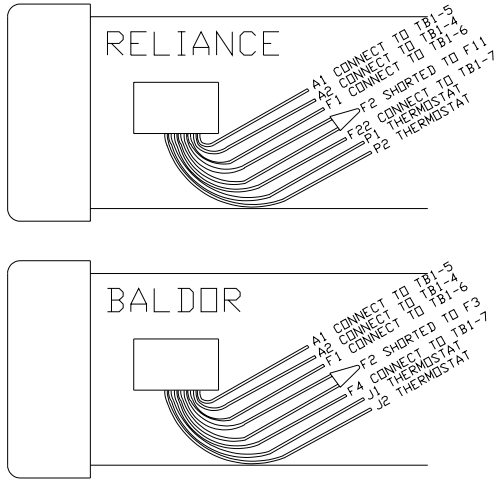


2 HP TEFC MOTOR



FIELD WOUND MOTORS

1 & 2 HP EXPLOSION PROOF MOTORS



CROSS REF

BALDOR	RELIANCE
F3	F11
F4	F22
J1	P1
J2	P2

NOTES:

1. THE MOTOR CONNECTIONS SHOWN WILL PRODUCE A COUNTER-CLOCKWISE ROTATION OF THE REDUCER OUTPUT SHAFT, VIEWED FROM THE PUMP END (AS OPPOSED TO THE MOTOR END). THIS ROTATION SHOULD BE CORRECT FOR MOST APPLICATIONS. IF ROTATION IS INCORRECT, REVERSE THE A1 AND A2 CONNECTIONS.
2. IF THE MOTOR IN USE HAS A THERMOSTAT, IT MAY BE CONNECTED TO TB2-5 AND TB2-6, AFTER REMOVING THE JUMPER.

TO GET ASSISTANCE, CALL: 919-774-7667
ZENITH PUMPS

Zenith Pumps

ZENITH PUMPS

Zenith Pumps
5910 Elwin Buchanan Drive
Sanford, NC 27330

Phone: 800-277-8968
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E-mail: zenithpumps@zenithpumps.com